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RAILWAY
MECHANICAL ENGINEER

Accessibility of Principal Units a Feature of

Baldwin Diesel Switcher

Top front view of Baldwin 660-hp. Diesel switcher

De La Vergne 660-hp. Diesel engine and Allis-Chalmers electrical equipment installed in Baldwin 100-ton switcher. The design and arrangement of engine and major assemblies make parts readily accessible. Maximum tractive force, 63,600 lb. Speed at continuous rating is 5.7 m. p. h.; maximum speed is 45 m. p. h.

In designing locomotive No. 62,000, a 100-ton Diesel-electric switcher recently completed at its Eddystone (Pa.) plant the Baldwin Locomotive Works paid particular attention to the design and arrangement of engine and major assemblies so as to produce a locomotive in which all parts would be readily accessible. The objective in this design was to develop a locomotive especially suited to the conditions of switching service and one in which maintenance costs would be at a minimum.

The basic feature of the design of the locomotive as a whole is the mounting of the engine, main and auxiliary generators, engine radiators, cooling fans and traction-motor blower on a common subbase, thus assuring accurate alinement. The subbase is an integral steel casting mounted on bolting lugs which are a part of the main underframe of the locomotive. A resilient composition cork-rubber pad is inserted between the subbase and the main underframe to provide protection against rail shock.

This locomotive is powered with a recently-developed design of De La Vergne 660-hp. Diesel engine and Allis-Chalmers electrical equipment. The basic design, however, provides for the use of electrical equipment of other manufacturers, as specified by the purchaser. The locomotive operating alone, is designed to negotiate a curve of 50 ft. radius and, operating with a train, to negotiate a curve having a radius of 120 ft. The maximum speed is 45 m. p. h. The general characteristics of the locomotive are given in the table.

Locomotive No. 62,000 will be used in the immediate future for demonstration service on a number of railroads.

The De La Vergne Engine

The prime mover is a De La Vergne Model VO four-cycle, solid injection, cold starting Diesel engine. It has a cylinder bore of 12½ in., a piston stroke of 15½ in. and is rated at 660 b.hp. at 600 r.p.m.

A feature of this engine is the spherically shaped combustion chamber which is cast integral with the cylinder head and is connected with the cylinder combustion space by a throat. The contour of the chamber and throat is such that air rushing in from the cylinder during the compression stroke creates a turbulence which induces a thorough mixing of the air with the atomized fuel.

The fuel-injection equipment is of the Bosch type with an individual fuel pump for each cylinder and a spray valve which enters the side of each spherical combustion chamber. Direct combustion occurs in this chamber which is offset from the center line of the cylinder and is entirely surrounded by water jacketing. This results in lower operating temperatures of valves, pistons, piston

rings and cylinder liners, complete combustion and advantageous lubrication conditions.

The offset position of the combustion chamber and the elimination of a central vertical spray nozzle permit the use of a large single exhaust and a single inlet valve for each cylinder. The use of two valves, instead of four, simplifies the valve gear and allows a shorter and more compact cylinder block, as well as more space for cooling-water circulation.

The engine frame is a single rigid casting designed to obviate the necessity for through bolts or tie rods. This method of construction makes possible a very rigid and compact cylinder-block casting. Crankshaft-bearing supports are attached to the engine frame. The upper and lower main bearing shells can be taken out while the engine is in place by removal through the crankcase doors. The compact cylinder block makes it possible to reduce the length of the crankshaft.

Piston-ring grooves are cut in an aluminum-bronze collar cast in the aluminum piston. This harder alloy resists wear and lengthens the life of piston and rings as the grooves do not pound out of shape as in the softer metal of the piston body. The absence of a central spray nozzle in the cylinder head makes possible a flat, smooth piston top. Due to low operating temperatures of pistons and adjacent parts there is less expansion and tendency to bind. Therefore, piston diameters can be made closer to cylinder diameters, a feature which prevents excessive rocking of the piston as a result of piston and connecting-rod reactions.

Cylinder liners are lapped into the cylinder block with a metal-to-metal fit.

Engine speed is controlled by a Woodward variable-speed governor which is mechanically connected to the operator's station so that the Diesel engine can be adjusted to any required speed.

Electrical Equipment

The electrical equipment for this locomotive was furnished by the Allis-Chalmers Manufacturing Company. The main generator is driven direct by the Diesel engine, both being mounted on a common base as previously mentioned. The commutator shaft is connected to the engine by means of a self-aligning coupling. The generator is both self-excited and separately excited and is of the self-ventilated, interpole type, furnishing d.c. power to the traction motors at a maximum of 600 volts. The voltage characteristics of the generators are such that, with increasing current, the voltage is reduced so that the maximum current, under any conditions, is only equal to the maximum starting current of the traction motors.

The self-excited, variable-speed auxiliary generator mounted on the main generator shaft delivers full power at from half to full engine speed to all auxiliary motors such as those of the traction-motor blower, radiator fan and air compressor. It also provides current for battery charging.

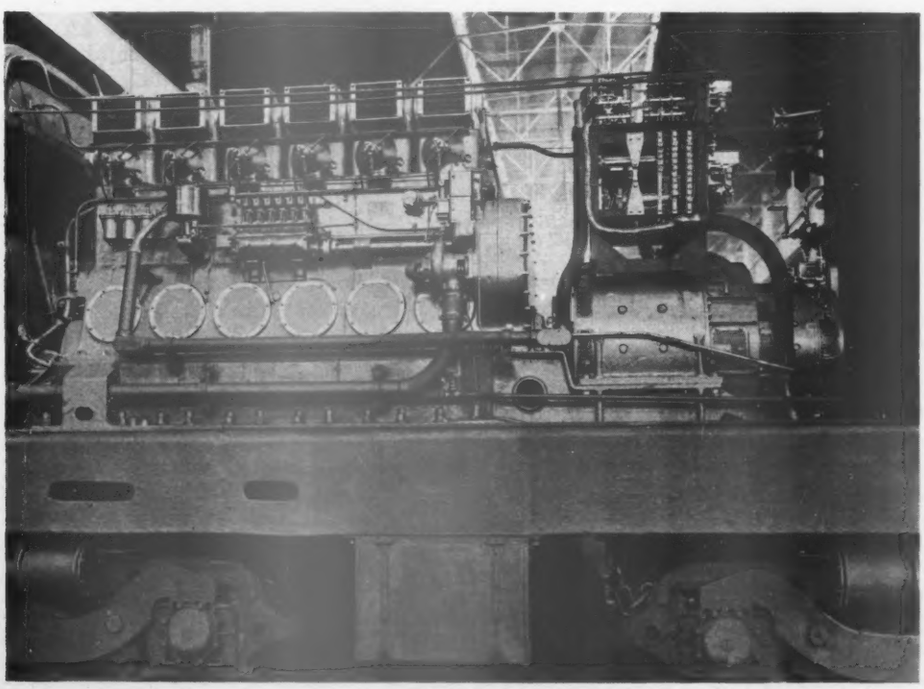
Characteristics of Baldwin Diesel-Electric Switcher

Weight on drivers, loaded, lb.	212,000
Weight on drivers, light, lb.	200,000
Length inside coupler knuckles, ft. and in.	39-6
Height to top of cab, ft. and in.	14-3
Height of engine hood, ft. and in.	14-0
Width overall, ft. and in.	10-2
Width of engine hood, ft. and in.	5-6
Rigid wheel base, ft. and in.	8-0
Total wheel base, ft. and in.	26-0
Fuel oil capacity, gal.	500
Lubricating oil capacity, gal.	130
Water capacity, gal.	248
Sand capacity, lb.	2,200
Tractive force (30 per cent adhesion), lb.	63,600
Tractive force at continuous rating of motors, lb.	29,900
M.p.h. at continuous rating of motors	5.7
Maximum speed, m.p.h.	45.0

A traction-motor blower is mounted under the hood on the subbase casting. Air is delivered to an opening in the main frame which carries it to the two truck center pins. From there it is delivered to the traction motors.

The control is arranged with the four traction motors connected in parallel. This simplifies the control circuits in that no transition from series to series parallel is required. With the parallel connection of traction motors the tendency for continued slipping of the wheels of the locomotive is reduced.

The Allis-Chalmers automatic Servo field regulator is installed on this locomotive. This electro-mechanical device is a main-generator field-excitation regulator interlocked with the Diesel-engine governor and connected



A close-up of the locomotive during construction with the hood removed showing power plant

The underframe is an integral steel casting in which are contained the 500-gal. fuel oil tank, storage-battery compartment, sand boxes and motor air ducts

to a resistor in the circuit of the separately excited field of the main generator. This device regulates the main-generator excitation, not as a function of the electrical conditions, but entirely through the governor of the Diesel engine. It automatically increases the generator voltage as the motor current decreases, so that the engine load is constant at all times within the operating range of the locomotive, regardless of the speed or tractive force.

If one or more Diesel-engine cylinders become inoperative, the main-generator output is automatically reduced to correspond with the reduced engine output so that the engine is not overloaded.

An electrical equipment box is located under the main frame between the trucks. It houses the equipment connected in the main power circuits along with the necessary wiring. The box has hinged doors on all four sides, making wiring and electrical devices easily accessible.

Other Features of Construction

The underframe of the locomotive is an integral steel casting in which are incorporated bolting lugs for the engine-generator subbase, 500-gallon fuel oil tank, storage-battery compartment, sand boxes, cab steps, traction motor air ducts, and housings for draft gear and truck center pins. Storage-battery compartments are easily accessible through trap doors for filling or replacing batteries. The interiors of the compartments are protected with acid-resisting paint.

The four-wheel swivel trucks have integral cast-steel frames, incorporating air passages through the center pin and bolster to the motor inlet. The rolled-steel wheels are 40 in. in diameter. The journals are equipped with Timken roller bearings, but friction bearings can be used on a locomotive of this type if desired. The pedestal ways of the truck frame and boxes are lined with manganese steel and provided with oil pockets to lubricate the wearing faces.

A feature of the truck design is the provision for dropping a set of wheels without removing the traction motor from the axle.

The weatherproof engine hood is of steel plate, having removable top with sliding hatches and removable hinged doors alongside the engine and generator, giving access to parts requiring attention and possible replacement. The entire roof and sides of the hood can be removed if desired. The front section houses the radiators, cooling fan and motor, traction-motor blower and the compressor compartment.

The radiators are mounted vertically in the sides of the hood to prevent blanketing and insure a free circulation of air even though the front of the locomotive may be close against a box car or other high piece of equipment. The radiators have a capacity of 248 gallons of water and sufficient additional capacity to cool the engine lubricating oil. Radiator-fan speed can be controlled by the operator who thus adjusts cooling-water temperature to suit outside weather conditions.

Fuel is pumped from the tank in the main underframe by a geared pump driven by a ¼-hp. motor to filters, mounted in the hood. After going through the filters, the oil passes into an auxiliary tank under the top of the hood. This tank holds 12 gallons and its purpose is to insure a supply of fuel for several hours' operation in case of an accident to the fuel pump. Fuel is fed by gravity from the auxiliary tank to the engine pump, thence to the Bosch fuel pump and sprayed into the combustion chamber.

An emergency hand pump is placed in the fuel-oil line between the main reservoir and the strainer to be used in the rare event that the motor-driven pump fails. An emergency fuel cut-off valve is installed on the locomotive and can be actuated by either one of two handles, one located in the cab and the other on the outside of the frame.

The steel cab is entirely lined and floored with cork. Doors are of pressed steel and window frames are of extruded aluminum. The entire locomotive, including engine, generator, traction motor, auxiliaries, lights and various accessories, is controlled from the cab. The control stand is on the right side. The operator not only has clear vision directly in front of him on the right-hand side, but clear vision is also provided forward along the left-hand side by a suitable mirror. The hood is only 66 in. wide which gives excellent visibility. All doors and windows are weather-stripped and an automatic hot-water heater provides comfort in winter. Windshield wipers and awnings are regular equipment.

The accessories used on this locomotive include the following: Miner A-22XB friction draft gear; Type E A.A.R. swivel-shank top operating couplers; bell with internal quick-acting bell ringer; Pneuphonic horn; Sunbeam 12-in. round-case headlights built into cab and hood, respectively, and King top-operated sanders.

Passenger Cars Air-Conditioned During 1936

Railroad	No. of Cars	Type of Cars	Type of System	Manufacturer	Compressor Drive	Refrigerant	Generators: No.	Generators: Capacity Kw.	Generators: Type of Drive	Generators: Type of Mounting	Storage Batteries: Make	Storage Batteries: Amp.-Hr. Capacity	Outside Power Supply: a.c. or d.c.	Outside Power Supply: Phase	Outside Power Supply: Cycles	Outside Power Supply: Volts
A. T. & S. F.	6	Chair	St. ejec.	Safety C. H. & L.	.....	Water	2	1-2 1-5	Flat belt	Truck	Exide	850	.....	..	..	...
	8	Chair	St. ejec.	Safety C. H. & L.	.....	Water	2	1-2 1-4	Flat belt	Truck	Exide	850	.....	..	..	...
	6	Coaches	St. ejec.	Safety C. H. & L.	.....	Water		1-5 1-2	Flat belt	Truck	Exide	850	.....	..	..	...
	12	Coaches	St. ejec.	Safety C. H. & L.	.....	Water	2	1-4 1-2	Flat belt	Truck	Exide	850	.....	..	..	...
	1	Diner	St. ejec.	Safety C. H. & L.	.....	Water	1	7½	Flat belt	Truck	Exide	850	.....	..	..	...
	2	Chair	St. ejec.	Safety C. H. & L.	.....	Water	1	7½	Flat belt	Truck	Exide	850	.....	..	..	...
	16	Chair	St. ejec.	Safety C. H. & L.	.....	Water	2	1-2 1-4	Flat belt	Truck	Exide	850	.....	..	..	...
A. C. L.	50	Coaches	St. ejec.	Safety C. H. & L.	.....	Water	1	10	Flat belt	Body	Edison	600	.....	..	..	...
	3	Diners	St. ejec.	Safety C. H. & L.	.....	Water	1	10	Flat belt	Body	Edison	600	.....	..	..	...
B. & O.	10	Comb.	Elec.-Mech.	B. & O.-York	Motor	Freon	2	1-4 1-7½	Flat belt Flat belt-gear	Body	Exide, Gould, K. W. and U. S. L.	1,000	.....	..	..	...
	2	Comb.	Elec.-Mech.	B. & O.-York	Motor	Freon	2	6	Flat belt	Body	Exide	1,000	.....	..	..	...
	1	Coach	Elec.-mech.	B. & O.-York	Motor	Freon	2	6	Flat belt	Body	Exide	1,000	.....	..	..	...
	69	Coaches	Elec.-mech.	B. & O.-York	Motor	Freon	2	1-4 1-7½	Flat belt Flat belt-gear	Body	Exide, Gould, K. W. and U. S. L	1,000	.....	..	..	...
B. & M.	17	Coach	Ice	Sturtevant	.....	Ice	1	4	Flat belt	Body	Edison	256	.....	..	..	...
	2	Comb.	Ice	Sturtevant	.....	Ice	1	4	Flat belt	Body	Edison	256	.....	..	..	...
Can. Nat'l.	3	Diners	Ice	.....	.....	Ice	1	5	Flat belt in summer—chain in winter.	Truck	Edison, Exide and Gould	600	.....	..	..	...
	27	Chair	Ice	.....	.....	Ice	1	5		Truck						
	20	Sleepers	Ice	.....	.....	Ice	1	4		Truck						
Can. Pacific	43	Sleepers	Ice	.....	.....	Ice	1	3	Gear	Body	Gould Kathanode	600	.....	..	..	...
	32	Sleepers	Ice	.....	.....	Ice	1	3	Gear	Body	Edison	595	.....	..	..	...
	6	Sleepers	Ice	.....	.....	Ice	1	3	Gear	Body	Exide	585	.....	..	..	...
	6	Sleepers	Ice	.....	.....	Ice	1	3	Gear	Body	Gould Kathanode	600	.....	..	..	...
	3	Sleepers	Ice	.....	.....	Ice	1	3	Gear	Body	Exide	585	.....	..	..	...
	2	Sleepers	Ice	.....	.....	Ice	1	3	Gear	Body	Edison	680	.....	..	..	...
	5	Sleepers	Ice	.....	.....	Ice	1	3	V-belt-gear	Body	Gould Kathanode	600	.....	..	..	...
	1	Sleeper	St. ejec.	.....	.....	Water	1	7½	V-belt-gear	Body	Gould Kathanode	1,000	.....	..	..	...
	10	Obs.-sleeper	Ice	.....	.....	Ice	1	3	Gear	Body	Edison	595	.....	..	..	...
	1	Obs.-sleeper	Ice	.....	.....	Ice	1	3	V-belt-gear	Body	Edison	595	.....	..	..	...
	3	Obs.-sleeper	Mech.	.....	V-belt	Freon	1	3	Gear	Body	Edison	595	.....	..	..	...
	4	Obs.-lounge	Mech.	.....	V-belt	Freon	1	5	Flat belt	Body	Edison	680	.....	..	..	...
	2	Lounge-sleeper	Ice	.....	.....	Ice	1	4	Gear	Body	Exide	585	.....	..	..	...
	3	Diners	Ice	.....	.....	Ice	1	5	Gear	Body	Exide	585	.....	..	..	...
	8	Coaches	Ice	.....	.....	Ice	1	4	Gear	Body	Edison	510	.....	..	..	...
	4	Comb.	Ice	.....	.....	Ice	1	4	Gear	Body	Edison	510	.....	..	..	...
	2	Chair	Ice	.....	.....	Ice	1	5	Gear	Body	Exide	585	.....	..	..	...
	2	Chair	Ice	.....	.....	Ice	1	5	Gear	Body	Edison	595	.....	..	..	...
	2	Chair	Electro-mech.	.....	Motor	Freon	1	20	Gear	Body	Edison	1,190	.....	..	..	...
	2	Chair-buffet	Ice	.....	.....	Ice	1	5	Gear	Body	Exide	585	.....	..	..	...
Cen. of Ga.	9	Coaches	St. ejec.	Safety C. H. & L.	.....	Water	1	10	Flat belt	Body	Edison	750	.....	..	..	...
C. R. R. of N. J.	2	Comb.	Elec.-mech.	York	Motor	Freon	2	1-3 1-7½	Flat belt	Body	Edison	1,000	a. c.	3	60	220/440
	3	Coaches	Elec.-mech.	York	Motor	Freon	2	1-2 1-7½	Flat belt	Body	Edison	1,000	a. c.	3	60	220/440
C. & O.	2	Comb.	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	3	Flat belt	Body	Exide	350	a. c.	3	60	220
	2	Comb.	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	3	Flat belt	Body	U. S. L.	350	a. c.	3	60	220
	6	Coaches	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	4	Flat belt	Body	Exide	500	a. c.	3	60	220
	3	Coaches	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	3	Flat belt	Body	Exide	350	a. c.	3	60	220
	2	Diners	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	4	Flat belt	Body	Exide	500	a. c.	3	60	220
C. & E. I.	9	Coaches	St. ejec.	Safety C. H. & L.	.....	Water	1	10	V-belt-gear	Body	Gould	950	.....	..	..	...
	1	Diner	Ice	Safety C. H. & L.	.....	Ice	1	3	Flat belt	Body	U. S. L.	500	.....	..	..	...

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FEBRUARY, 1937

Passenger Cars Air-Conditioned During 1936 (Continued)

Passenger Cars Air-Conditioned During 1936 (Continued)

Railroad	No. of Cars	Type of Cars	Type of System	Manufacturer	Compressor Drive	Refrigerant	Generator: No.	Generator: Capacity Kw.	Generator: Type of Drive	Generator: Type of Mounting	Storage Batteries: Make	Storage Batteries: Amp.-Hr. Capacity	Outside Power Supply: a.c. or d.c.	Outside Power Supply: Phase	Outside Power Supply: Cycles	Outside Power Supply: Volts
C. & N. W.	2	Cafe-chair	Ice	Trane	.....	Ice	..	..	.....	.....	.....	....	....	..	..	...
	23	Coaches	Mech.	Waukesha	Gas engine	Freon	..	..	.....	.....	.....	....	....	..	..	...
	6	Chair	Mech.	Waukesha	Gas engine	Freon	..	..	.....	.....	.....	....	....	..	..	...
	11	Diners	Mech.	Waukesha	Gas engine	Freon	..	..	.....	.....	.....	....	....	..	..	...
	3	Lounge	Mech.	Waukesha	Gas engine	Freon	..	..	.....	.....	.....	....	....	..	..	...
C. B. & Q.	8	Coaches	Elec.-mech.	Trane	Motor	Freon	1	20	V-belt-gear	Body	Lead	1,000	a. c.	3	60	220
	4	Lounge	Elec.-mech.	Frigidaire	Motor	Freon	Three 50-kw. generators on each of two 7-car streamlined trains and four 50-kw. generators on each of two 12-car trains, driven by auxiliary Diesel engines.						a. c.	3	60	220
	4	Diners	Elec.-mech.	Frigidaire	Motor	Freon										
	4	Chair-lounge	Elec.-mech.	Frigidaire	Motor	Freon										
	2	Chair	Elec.-mech.	Frigidaire	Motor	Freon										
	8	Sleepers	Elec.-mech.	Frigidaire	Motor	Freon										
C. M. St. P. & P.	2	Diner	St. ejec.	Safety C. H. & L.	.....	Water	1	10	V-belt	Truck	Exide	850	....	..	..	...
	2	Lounge	St. ejec.	Safety C. H. & L.	.....	Water	1	10	V-belt	Truck	Exide	850	....	..	..	...
	13	Chair	St. ejec.	Safety C. H. & L.	.....	Water	1	10	V-belt	Truck	Exide	850	....	..	..	...
	17	Coaches	St. ejec.	Safety C. H. & L.	.....	Water	1	10	V-belt	Truck	Exide	850	....	..	..	...
	2	Sleepers	Mech.	Waukesha	Gas engine	Freon	1	4	V-belt	Body	Exide	450	....	..	..	...
	37	Sleepers	St. ejec.	Safety C. H. & L.	.....	Water	1	10	V-belt	Truck	Exide	850	....	..	..	...
C. R. I. & P.	49	Coaches	Ice	A. C. F.	.....	Ice	1	2.6, 3 or 4	Flat belt	Body	.....	450	....	..	..	...
	16	Chair	Ice	A. C. F.	.....	Ice	1									
	4	Diners	Ice	A. C. F.	.....	Ice	1									
	2	Diners	Mech.	Waukesha	Gas engine	Freon	1	4	Flat belt	Body	U. S. L.	450	....	..	..	...
D. & H.	1	Chair-cafe	Ice	Safety C. H. & L.	.....	Ice	..	..	.....	.....	Exide	500	....	..	..	...
	3	Diners	Ice	Safety C. H. & L.	.....	Ice	..	..	.....	.....	Exide	500	....	..	..	...
D. L. & W.	5	Coaches	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	3	Flat belt	Body	Lead	450	a. c.	3	60	220
	5	Coaches	Elec.-mech.	Airtemp	Motor	Freon	1	20	V-belt-gear	Body	Edison	1,000	a. c.	3	60	220
	2	Diners	Ice	Safety C. H. & L.	.....	Ice	1	4	Flat belt	Body	Lead	450	....	..	..	...
D. & R. G. W.	3	Lounge-diners	Ice	Young	.....	Ice	1	4	Flat belt	Body	K. W.	520	....	..	..	...
	5	Coaches	Ice	Young	.....	Ice	1	4	Flat belt	Body	K. W.	520	....	..	..	...
Erie	1	Business	Mech.	P. S. C. M. C.	Speed reducer	Freon	2	4½	.....	.....	Edison	....	a. c.	3	60	220
Fla. East Coast	8	Coaches	St. ejec.	Safety C. H. & L.	.....	Water	2	1–3 1–4	Flat belt	Body	Edison	600	....	..	..	...
	10	Coaches	St. ejec.	Safety C. H. & L.	.....	Water	1	10	Flat belt	Body	Edison	600	....	..	..	...
	3	Diners	St. ejec.	Safety C. H. & L.	.....	Water	2	1–3 1–5	Flat belt	Body	Edison	750	....	..	..	...
Gr. Northern	4	Coaches	Ice	R. R. Co.	.....	Ice	1	4	V-belt	Body	2 Exide; 2 Gould	500	....	..	..	...
	4	Diners	Ice	R. R. Co.	.....	Ice	1	4	V-belt	Body	Exide	500	....	..	..	...
Ill. Cent.	3	Business	Ice	A. C. F.	.....	Ice	2	3	Flat belt	Body	Edison	900	....	..	..	...
	57	Coaches	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	3	Flat belt	Body	41 Edison; 21 Lead	375	a. c.	3	60	220
	3	Chair	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	3	Flat belt	Body						
	1	Cafe-lounge	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	3	Flat belt	Body						
	1	Comb.	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	3	Flat belt	Body						
L. & N.	39	Coaches	St. ejec.	Safety C. H. & L.	.....	Water	1	10	Flat belt	Body	Exide and Edison	800	....	..	..	...
Maine Cent.	5	Coaches	Ice	Sturtevant	.....	Ice	1	4	Flat belt	Body	Edison	340	....	..	..	...
M. St. P. & S. Ste. M.	3	Diners	Mech.	Waukesha	Gas engine	Freon	1	3	Flat belt	Body	Gould	600	....	..	..	...
	4	Lounge	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	4	Flat belt	Body	Gould	600	a. c.	3	60	220
Mo. Pac.	5	Comb.	Ice	R. R. Co.	.....	Ice	1	3	Flat belt	Body	Edison	375	....	..	..	...
	3	Comb.	Ice	R. R. Co.	.....	Ice	1	4	Flat belt	Body	Edison	300	....	..	..	...
	3	Chair	Ice	R. R. Co.	.....	Ice	1	4	Flat belt	Body	Edison	375	....	..	..	...
	1	Chair	Ice	R. R. Co.	.....	Ice	1	3	Flat belt	Body	Edison	600	....	..	..	...
	5	Chair	St. ejec.	Safety C. H. & L.	.....	Water	2	4	Flat belt	Body	Edison	750	....	..	..	...
	18	Chair	Ice	R. R. Co.	.....	Ice	5–1	4	Flat belt	Body	Edison	3–600	....	..	..	...
							13–2	3	Flat belt	Body	Edison	11–375 4–450	....	..	..	...

Passenger Cars Air-Conditioned During 1936 (Continued)

Railroad	No. of Cars	Type of Cars	Type of System	Manufacturer	Compressor Drive	Refrigerant	Generators: No.	Generators: Capacity Kw.	Generators: Type of Drive	Generators: Type of Mounting	Storage Batteries: Make	Storage Batteries: Amp.-Hr. Capacity	Outside Power Supply: a.c. or d.c.	Outside Power Supply: Phase	Outside Power Supply: Cycles	Outside Power Supply: Volts
Mo. Pac. (Continued)	7	Grill-coaches	Ice	R. R. Co.	.....	Ice	1	4	Flat belt	Body	Edison	375	....	..	..	...
	1	Coach-diner	Elec.-mech.	Frigidaire	Motor	Freon	1	20	V-belt-gear	Body	Edison	1,000	a. c.	3	60	220
	2	Cafe-coach	St. ejec.	Safety C. H. & L.	.....	Water	2	4	Flat belt	Body	Edison	750	....	..	..	...
	5	Cafe-coach	Ice	R. R. Co.	.....	Ice	1	4	Flat belt	Body	Edison	375	....	..	..	...
	2	Chair-diners	Elec.-mech.	Frigidaire	Motor	Freon	1	15	V-belt-gear	Body	Gould	1,000	a. c.	3	60	220
	3	Chair-diners	St. ejec.	Safety C. H. & L.	.....	Water	2	4	Flat belt	Body	Edison	750	....	..	..	...
	4	Chair-diners	Ice	R. R. Co.	.....	Ice	2	3	Flat belt	Body	Edison	450	....	..	..	...
	1	Coach-diner	Ice	R. R. Co.	.....	Ice	1	4	Flat belt	Body	Edison	375	....	..	..	...
	1	Lounge-diner	Ice	R. R. Co.	.....	Ice	2	3	Flat belt	Body	Edison	375	....	..	..	...
	4	Coach	St. ejec.	Safety C. H. & L.	.....	Water	2	4	Flat belt	Body	Edison	750	....	..	..	...
	52	Coach	Ice	R. R. Co.	.....	Ice	36–1 26–2	4 3	Flat belt Flat belt	Body Body	Edison Edison	35–375 2–450 25–600	....	..	..	...
	2	Coach-chair	St. ejec.	Safety C. H. & L.	.....	Water	2	4	Flat belt	Body	Edison	750	....	..	..	...
	1	Business	Elec.-mech.	Frigidaire	Motor	Freon	2	1–10 1–20	Gear	1–Body 1–Truck	Gould	2,000	a. c.	3	60	220
	4	Business	Ice	R. R. Co.	.....	Ice	2	4	Flat belt	Body	Edison	750	....	..	..	...
	3	Lounge-diners	Elec.-mech.	Westinghouse	Motor	Freon	1	20	V-belt-gear	Body	Edison	1,000	a. c.	3	60	220
	3	Lounge-diners	Elec.-mech.	Frigidaire	Motor	Freon	2	20	V-belt-gear	Body	Edison	1,000	a. c.	3	60	220
		Lounge-diners	St. ejec.	Safety C. H. & L.	.....	Water	1 2–2 4–2 1–1	15 4 1–10 1–4 10	Flat belt V-belt-gear V-belt-gear	Body	Edison	3–750 4–975	....	..	..	...
	1	Diner	Mech.	Waukesha	Gas engine	Freon	2	3	Flat belt	Body	Edison	375	....	..	..	...
	5	Diners	Elec.-mech.	Frigidaire	Motor	Freon	4–1 1–1	20 15	V-belt-gear	Body	3 Exide and 2 Edison	1,000	a. c.	3	60	220
	1	Diner	St. ejec.	Safety C. H. & L.	.....	Water	2	4	Flat belt	Body	Edison	750	....	..	..	...
N. C. & St. L.	1	Diner	St. ejec.	Safety C. H. & L.	.....	Water	1	10	Flat belt	Body	Edison	850	....	..	..	...
	7	Coaches	St. ejec.	Safety C. H. & L.	.....	Water	1	10	Flat belt	Body	Edison	850	....	..	..	...
N. Y. C. System	28	Diners	Elec.-mech.	Frigidaire	Motor	Freon	1	20	Gear	Truck	Exide, Gould and K. W.	600 at 64 v.	....	..	..	...
	1	Diner	Elec.-mech.	Frigidaire	Motor	Freon	1	20	Gear	Body	Gould	600 at 64 v.	a. c.	3	60	220
	3	Coaches	Elec.-mech.	Frigidaire	Motor	Freon	1	20	Gear	Body	Exide, Gould	600 at 64 v.	a. c.	3	60	220
	25	Coaches	Elec.-mech.	Frigidaire	Motor	Freon	1	20	Gear	Truck	Exide, K. W. and U. S. L.	600 at 64 v.	....	..	..	...
	1	Comb.	Elec.-mech.	Frigidaire	Motor	Freon	1	20	Gear	Body	Gould	600 at 64 v.	a. c.	3	60	220
	1	Kitchen-coach	Elec.-mech.	Frigidaire	Motor	Freon	1	20	Gear	Body	Exide	600 at 64 v.	a. c.	3	60	220
	1	Lounge	Elec.-mech.	Frigidaire	Motor	Freon	1	20	Gear	Body	Exide	600 at 64 v.	a. c.	3	60	220
	1	Chair	Elec.-mech	Frigidaire	Motor	Freon	1	20	Gear	Body	Gould	600 at 64 v.	a. c.	3	60	220
	1	Obs.-chair	Elec.-mech.	Frigidaire	Motor	Freon	1	20	Gear	Body	Exide	600 at 64 v.	a. c.	3	60	220
N. Y. C. & St. L.	2	Coaches	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	4	V-belt	Body	Exide	286	a. c.	3	60	220
N. Y., N. H. & H.	46	Coaches	Ice	Sturtevant	.....	Ice	..	..	.....	.....	Exide	450	....	..	..	...
	50	Coaches	Elec.-mech.	Frigidaire	Motor	Freon	1	20	V-belt-gear	Body	Exide	500	30–a. c. 20–none	3	60	220
	15	Coaches	Elec.-mech.	Safety C. H. & L.	Motor	Freon	1	15	V-belt-gear	Body	Exide	1,000	....	..	..	...
	1	Comb.	Ice	Safety C. H. & L.	.....	Ice	..	..	.....	.....	Exide	450	....	..	..	...
	1	Club	Ice	Sturtevant	.....	Ice	..	..	.....	.....	Exide	322	....	..	..	...
	4	Diners	Ice	Safety C. H. & L.	.....	Ice	..	..	.....	.....	Exide	500	....	..	..	...
	1	Comb.	Elec.-mech.	Safety C. H. & L.	Motor	Freon	Note: Two-car steam rail train. One 25 kw. generator driven by auxiliary steam engine supplies train power.				Exide	1–225 for train	....	..	..	...
	1	Coach	Elec.-mech.	Safety C. H. & L.	Motor	Freon							....	..	..	...
N. & W.	38	Coaches	Elec.-mech.	Frigidaire	Motor	Freon	1	20	Gear	Body	Edison	300 at 110 v.	a. c.	3	60	220
	2	Coaches	Elec.-mech.	Frigidaire	Motor	Freon	1	20	Gear	Body	Lead	300 at 110 v.	a. c.	3	60	220
	7	Comb.	Elec.-mech.	Frigidaire	Motor	Freon	1	20	Gear	Body	Edison	300 at 110 v.	a. c.	3	60	220
	3	Business	Ice	Trane	.....	Ice	1	20	V-belt-gear	Body	Lead	300 at 110 v.	....	..	..	...
Nor. Pac.	4	Coaches	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	4	V-belt	Body	Exide	600	a. c.	3	60	220
	2	Chair	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	4	V-belt	Body	Gould	600	a. c.	3	60	220
	2	Diners	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	4	V-belt	Body	Gould	600	a. c.	3	60	220
Pennsylvania	94	Coaches	Ice	R. R. Co.	.....	Ice	1	4.8	Flat belt	Body	.....	500	....	..	..	...
	23	Comb.	Ice	R. R. Co.	.....	Ice	1	4.8	Flat belt	Body	.....	500	....	..	..	...
	13	Diners	Elec.-mech.	Frigidaire	Motor	Freon	1	15	11–Gear 2–V-belt	Body	.....	800	....	..	..	...
	3	Diners	Elec.-mech.	Airtemp	Motor	Freon	1	15	V-belt	Body	.....	800	....	..	..	...

Passenger Cars Air-Conditioned During 1936 (Continued)

	3	Diners	Elec.-mech.	Airtemp	Motor	Freon	1	15	V-belt	Body	.....	800	....	..	..	...

Passenger Cars Air-Conditioned During 1936 (Continued)

Railroad	No. of Cars	Type of Cars	Type of System	Manufacturer	Compressor Drive	Refrigerant	Generators				Storage Batteries		Outside Power Supply			
							No.	Capacity Kw.	Type of Drive	Type of Mounting	Make	Amp.-Hr. Capacity	a.c. or d.c.	Phase	Cycles	Volts
Pullman Co.	24	Sleepers	Elec.-mech.	P. S. C. M. C.	Motor	Freon	2	1–15 1–4	V-belt-gear Flat belt	Body	Exide	1,000	a. c.	3	60	220
	3	Chair	Elec.-mech.	P. S. C. M. C.	Motor	Freon	2	1–15 1–4	V-belt-gear Flat belt	Body	Exide	1,000	a. c.	3	60	220
	16	Sleepers	Elec.-mech.	P. S. C. M. C.	Motor	Freon	Note: Four streamlined trains. Two 75-k. w. Diesel-engine-driven generators on two 11-unit trains; three 75-k. w. Diesel-engine-driven generators on two 12-unit trains.				Exide	2–450 on each train	a. c.	3	60	220
	492	Sleepers	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	4	Flat belt	Body	Exide	550	a. c.	3	60	220
	5	Sleepers	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	7½	V-belt-gear	Body	Exide	550	a. c.	3	60	220
	2	Sleeper	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	4	Flat belt	Body	Exide	600	a. c.	3	60	220
	1	Sleeper	Mech.	P. S. C. M. C.	Speed reducer	Freon	..	..	.....	.....	.....	....	a. c.	3	60	220
	8	Chair	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	4	Flat belt	Body	Exide	550	a. c.	3	60	220
	15	Sleepers	St. ejec.	Safety C. H. & L.	.....	Water	1	4	Flat belt	Body	Exide	850	....	..	..	...
	332	Sleepers	Ice	Pullman	.....	Ice	1	4	Flat belt	Body	Exide	600	....	..	..	...
	1	Sleepers	Ice	Pullman	.....	Ice	1	4	Flat belt	Body	Exide	550	....	..	..	...
	2	Sleepers	Ice	Pullman	.....	Ice	1	7½	V-belt-gear	Body	Exide	600	....	..	..	...
	17	Chair	Ice	Pullman	.....	Ice	1	4	Flat belt	Body	Exide	600	....	..	..	...
Reading	3	Comb.	Elec.-mech.	York	Motor	Freon	2	1–3 1–7½	Flat belt	Body	2 Exide; 1 K. W.	1,000	a. c.	3	60	220/440
	2	Cafe	Elec.-mech.	York	Motor	Freon	2	1–4 1–7½	Flat belt	Body	Exide	1,000	a. c.	3	60	220/440
	11	Coaches	Elec.-mech.	York	Motor	Freon	2	1–3 1–7½	Flat belt	Body	3 Exide; 3 K. W.; 5 U. S. L.	1,000	a. c.	3	60	220/440
St. L.-S. F.	11	Coaches	Ice	R. R. Co.	.....	Ice	1	4	Flat belt	Body	9 Exide; 2 U. S. L.	450	....	..	..	...
	1	Coach	Ice	R. R. Co.	.....	Ice	1	4	Flat belt	Body	K. W.	540	....	..	..	...
	1	Coach	Mech.	Waukesha	Gas engine	Freon	1	4	Flat belt	Body	Exide	450	....	..	..	...
	1	Buffet	Ice	R. R. Co.	.....	Ice	1	4	V-belt	Body	Exide	450	....	..	..	...
	2	Cafe-lounge	Ice	R. R. Co.	.....	Ice	1	5	V-belt	Body	Exide	860	....	..	..	...
S. A. L.	3	Coaches	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	4	Flat belt	Body	Edison	375	a. c.	3	60	220
	3	Rail cars	Mech.	A. C. F.	Gasoline engine	Freon	..	..	.....	....	.....	.....	....	..	..	...
	1	Business	Elec.-mech.	Waukesha	Motor	Freon	1	10	Gear	Body	Edison	900	a. c.	3	60	220
	1	Business	Elec.-mech.	Waukesha	Motor	Freon	1	10	V-belt-gear	Body	Edison	900	a. c.	3	60	220
Sou. Pac.	4	Coaches	Mech.	Waukesha	Gas engine	Freon	1	4	Flat belt	Body	Edison	375	....	..	..	...
	15	Chair	Ice	R. R. Co.	.....	Ice	1	4	Flat belt	Body	Edison	375 to 450	....	..	..	...
	12	Coaches	Ice	R. R. Co.	.....	Ice	1	4	Flat belt	Body	Edison					
	2	Cafe	Ice	R. R. Co.	.....	Ice	1	4	Flat belt	Body	Edison					
	14	Diners	Ice	R. R. Co.	.....	Ice	1	4 Kw. flat-belt, body-hung drives and 5 Kw. V-belt truck-mounted drives.			Edison	450	....	..	..	...
	13	Lounge	Ice	R. R. Co.	.....	Ice	1				Edison	600 to 750	....	..	..	...
	1	Cafe-coach	Ice	R. R. Co.	.....	Ice	1				Edison	375 to 600	....	..	..	...
	4	Cafe-lounge	Ice	R. R. Co.	.....	Ice	1				Edison	450	....	..	..	...
	48	Coaches	Ice	R. R. Co.	.....	Ice	1				Edison	375 to 600	....	..	..	...
	6	Chair	Ice	R. R. Co.	.....	Ice	1				Edison	375 to 600	....	..	..	...
Southern	7	Diners	St. ejec.	Safety C. H. & L.	.....	Water	1	7.5	Flat belt	Body	Exide	600	....	..	..	...
Tex. & Pac.	4	Coaches	Mech.	Waukesha-Sturtevant	Gas engine	Freon	1	4	Flat belt	Body	Edison	600	....	..	..	...
	1	Coach	Ice	R. R. Co.-Sturtevant	.....	Ice	1	4	Flat belt	Body	Edison	600	....	..	..	...
	1	Business	Mech.	Waukesha-Sturtevant	Gas engine	Freon	1	10	Flat belt	Body	Edison	900	....	..	..	...
Union Pac.	10	Diners	St. ejec.	Safety C. H. & L.	.....	Water	2	5	Flat belt	Body	Exide	1,000	....	..	..	...
	2	Chair	Elec.-mech	General Electric	Motor	Freon	1	20	V-belt-gear	Body	Exide	1,000	a. c.	3	60	220
	20	Chair	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	4	Flat belt	Body	Edison	500	a. c.	3	60	220
	2	Obs.	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	4	Flat belt	Body	Edison	500	a. c.	3	60	220
Wabash	30	Coaches	Ice	R. R. Co.	.....	Ice	25–1 5–1	3 4	Flat belt Flat belt	Body Body	3 Edison; 15 Exide; 1 Gould 8 K. W. and 3 U. S. L.	300 to 540	....	..	..	...
	5	Diners	Ice	R. R. Co.	.....	Ice	1	4	Flat belt	Body	2 Edison; 1 Gould; 1 K. W. and 1 U. S. L.	300 to 540	....	..	..	...
	4	Cafe-chair	Ice	R. R. Co.	.....	Ice	1	4	Flat belt	Body	1 Edison; 1 K. W. and 2 U. S. L.	426 to 540	....	..	..	...
	11	Cafe-lounge	Ice	R. R. Co.	.....	Ice	2–1 9–1	3 4	Flat belt	Body	2 Edison; 4 Exide and 5 U. S. L.	350 to 512	....	..	..	...
	2	Buffet-chair	Ice	R. R. Co.	.....	Ice	1	4	Flat belt	Body	Gould	300	....	..	..	...
	2	Business	Ice	R. R. Co.	.....	Ice	1	5	Flat belt	Body	Edison	512	....	..	..	...
West. Pac.	3	Coaches	St. ejec.	Safety C. H. & L.	.....	Water	2	1–3 1–5	Flat belt	Body	Edison	900	....	..	..	...
	1	Diner	St. ejec.	Safety C. H. & L.	.....	Water	2	1–4 1–5	Flat belt	Body	Edison	750	....	..	..	...
	3	Obs.-lounge	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	..	Flat belt	Body	Edison	750	....	..	..	...

Summary of Cars Air Conditioned During 1936

	Number of Cars	Type of Car							Type of System				Refrigerant Used		
		Coach	Combination	Dining (Note A)	Chair (Note B)	Observation	Sleeping (Note C)	Business	Electro-Mech.	Direct Mech.	Ice	Steam Ejector	Freon	Water	Ice
A. T. & S. F.	51	18	...	1	32	...	...	...	...	...	...	51	...	51	...
A. C. L.	53	50	...	3	...	...	...	...	...	...	...	53	...	53	...
B. & O.	82	70	12	...	...	...	...	...	82	...	...	...	82	...	...
B. & M.	19	17	2	...	...	...	...	...	...	...	19	...	...	...	19
Can. Nat'l	56	...	...	3	27	...	26	...	...	...	56	...	...	...	56
Can. Pac.	141	8	4	5	6	4	114	...	2	7	131	1	9	1	131
C. of Ga.	9	9	...	...	...	...	...	...	...	...	...	9	...	9	...
C. of N. J.	5	3	2	...	...	...	...	...	5	...	...	...	5	...	...
C. & O.	15	9	4	2	...	...	...	...	...	15	...	...	15	...	...
C. & E. I.	10	9	...	1	...	...	...	...	...	...	1	9	...	9	1
C. & N. W. (incl. C. St. P. M. & O.)	45	23	...	13	6	3	...	...	...	43	2	...	43	...	2
C. B. & Q. (incl. Ft. W. & D. C.)	30	8	...	8	6	...	8	...	30	...	...	...	30	...	...
C. M. St. P. & P.	73	17	...	2	13	2	39	...	...	2	...	71	2	71	...
C. R. I. & P.	71	49	...	6	16	...	...	...	...	2	69	...	2	...	69
D. & H.	4	...	...	4	...	...	...	...	...	...	4	...	...	...	4
D. L. & W.	12	10	...	2	...	...	...	...	5	5	2	...	10	...	2
D. & R. G. W.	8	5	...	3	...	...	...	...	...	...	8	...	...	...	8
Erie	1	...	...	...	...	...	...	1	...	1	...	...	1	...	...
F. E. C.	21	18	...	3	...	...	...	...	...	...	...	21	...	21	...
Great Nor.	8	4	...	4	...	...	...	...	...	...	8	...	...	...	8
Ill. Cen.	65	57	1	1	3	...	...	3	...	62	3	...	62	...	3
L. & N.	39	39	...	...	...	...	...	...	...	...	...	39	...	39	...
Me. Cen.	5	5	...	...	...	...	...	...	...	...	5	...	...	...	5
M. St. P. & S. Ste. M.	7	...	...	3	...	4	...	...	...	7	...	...	7	...	...
Mo. Pac.	154	66	8	46	29	...	...	5	15	1	114	24	16	24	114
N. C. & St. L.	8	7	...	1	...	...	...	...	...	...	...	8	...	8	...
N. Y. C. System	62	28	1	30	2	1	...	...	62	...	...	...	62	...	...
N. Y. C. & St. L.	2	2	...	...	...	...	...	...	...	2	...	...	2	...	...
N. Y. N. H. & H.	119	112	2	4	...	1	...	...	67	...	52	...	67	...	52
Nor. & West.	50	40	7	...	...	...	...	3	47	...	3	...	47	...	3
Nor. Pac.	8	4	...	2	2	...	...	...	...	8	...	...	8	...	...
Pennsylvania	133	94	23	16	...	...	...	...	16	...	117	...	16	...	117
Pullman Co.	918	...	...	...	28	...	890	...	43	508	352	15	551	15	352
Reading	16	11	3	2	...	...	...	...	16	...	...	...	16	...	...
St. L.-S. F.	16	13	...	3	...	...	...	...	...	1	15	...	1	...	15
Seaboard A. L.	8	6	...	...	...	...	...	2	2	6	...	...	8	...	...
Southern	7	...	...	7	...	...	...	...	...	...	...	7	...	7	...
Sou. Pac.	119	64	...	21	21	13	...	...	...	4	115	...	4	...	115
Tex. & Pac.	6	5	...	...	...	...	...	1	...	5	1	...	5	...	1
Union Pac.	34	...	...	10	22	2	...	...	2	22	...	10	24	10	...
Wabash	54	30	...	22	...	...	...	2	...	...	54	...	...	...	54
West. Pac.	7	3	...	1	...	3	...	...	...	3	...	4	3	4	...
	2,551	913	69	229	213	33	1,077	17	394	704	1,131	322	1,098	322	1,131

Note A—Includes lounge-diners, coach-diners, cafe-chair, cafe-coach, kitchen-coach and buffet cars.
Note B—Includes lounge-chair, coach-chair and observation-chair cars.
Note C—Includes lounge- and observation-sleepers.

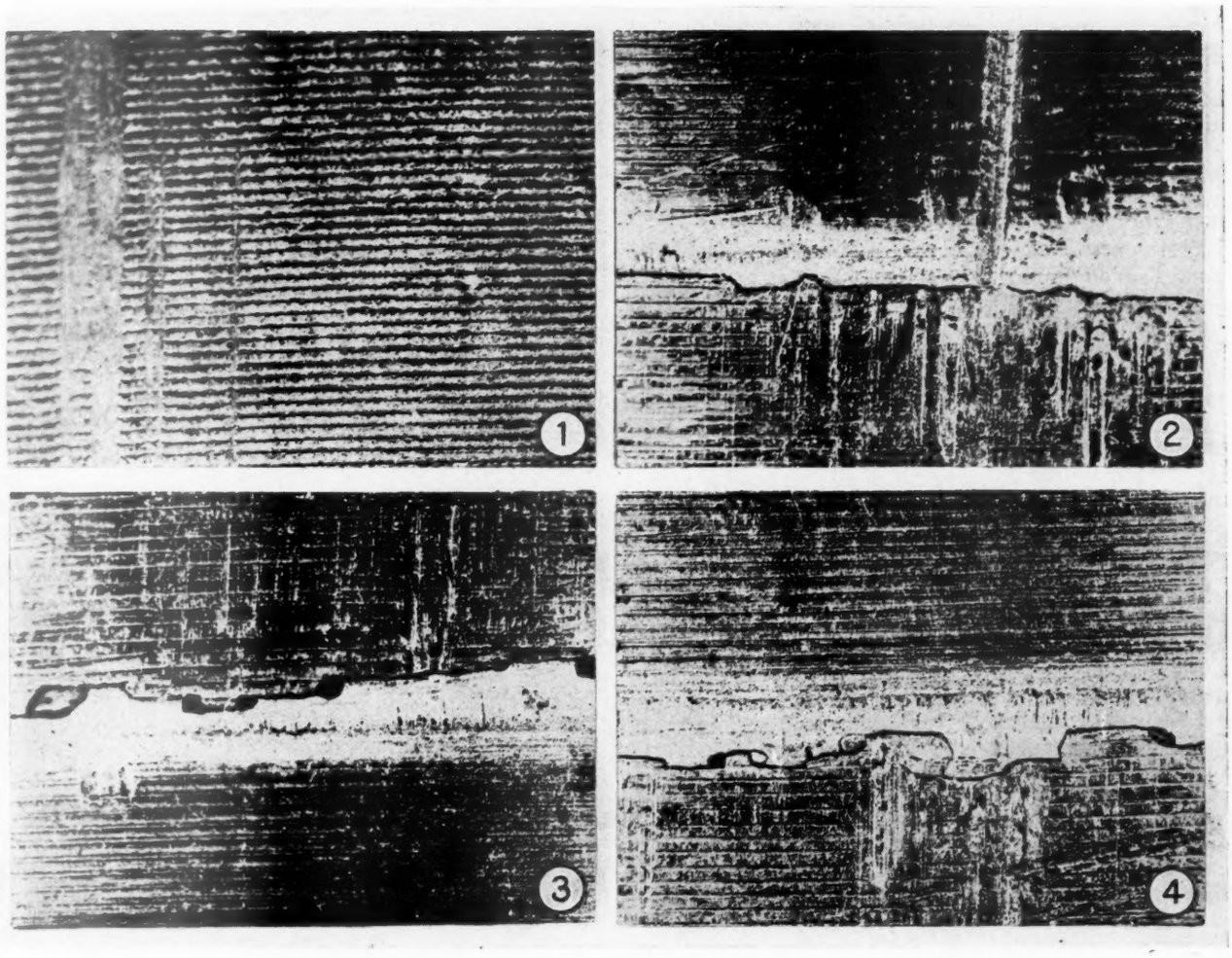


Fig. 1—Surface of the taper fit of a piston rod, enlarged about six times. A prolific cause of failures. Figs. 2, 3 and 4—Fractures caused by the rough finish of the taper fit of piston rods (enlarged about six times).

Failures of
Locomotive Parts*

By F. H. Williams†

THE finish of the taper fit of a piston rod is of first importance, and yet this is too frequently overlooked in these days of speed in production of repair jobs. Judging from the number of failures chargeable to this cause, we can profit greatly by making it a subject of thorough study and research, and of a campaign of education in the repair shops and enginehouses.

Formerly there were occasional failures because of poorly made fillets, where the rod is enlarged for the taper fit in the crosshead. One instance was called to my attention where the roughing cuts left almost a series of steps between the shank of the rod and the taper fit. As a matter of fact, the life of this particular rod was just about two miles—the piston head then went out of the end of the cylinder.

Today special attention is given to the finish of these fillets, with the result that failures at this point have practically disappeared. We cannot, however, be satisfied until the failures of all kinds are eliminated. The greatest progress can, of course, be made by tackling the points of greatest weakness. Many failures are caused by poor finish of the taper of the piston rod which fits into the crosshead. One type of such failures was considered in the preceding article of this series. It is true that there are now fewer failures in the taper fit than for-

* Part eight of an article which began in the May, 1936, issue.
† Assistant test engineer, Canadian National Railways.

merly, but we cannot be satisfied until conditions are improved to a point which will eliminate them entirely.

An example of the kind of finish we do not want to have on the taper fit is shown in Fig 1. This is a magnification of about six diameters; the cutting tool made about 70 threads to the inch. There is no question but what there are hundreds of such rods in service. As a matter of fact, I have seen some shopmen who argued that this was a satisfactory and proper finish, yet there is little question in my mind but what it has been the cause of many failures.

Several failures which were caused by cracks starting from such rough machining are shown in Figs. 2, 3 and 4. It is rather startling to note the way in which the cracks follow along the tool marks. I have known instances where the crack followed the tool marks half way around the circumference of the rod. Aside from the failures of such poorly finished taper fits, it is doubtful if the fit in the crosshead is at all comparable with a smooth finished job.

Improper Taper Fits

A taper fit which was poorly finished and filed and which failed in service is shown in Figs. 5 and 6. This fracture started with a fatigue crack, the progress of which was at first slow. Quite obviously the finish is crude, and yet I have seen worse jobs, which, needless to say, would not have come to my attention had they not been the cause of eventual failure. It will be noted in Fig. 5 that while the fatigue crack started from the surface, some distance from the keyway, the final break passed through the end of the keyway. That the finish of the hole which was drilled in the keyway was not above criticism, is indicated by the score marks which clearly appear on its walls. Let me emphasize the fact that the inferior workmanship above mentioned is not confined to any one shop or to any one road. Examples similar to those illustrated will be found in many places.

A piston rod which disclosed several cracks in the taper fit and which was withdrawn from service before the rod failed, is shown in Figs. 7 and 8. The fatigue cracks are not very pronounced, but may be seen between the daubs of paint. In all instances they followed the tool marks and undoubtedly would have resulted in a complete fracture in a very short time, had they not been discovered when the engine was being repaired. It will be noted that there were cracks about midway on the taper fit on both sides of the rod and that there were also cracks just ahead of the keyway. In the latter case the corrosion band shows clearly, and the cracks are undoubtedly due to a combination of tool marks and stress-corrosion. It will also be noted that the edges of the keyway are sharp, and not rounded as they should be. It is apparent, also, that the rod did not fit properly, since the tool marks are practically rubbed out on part of the taper fit, but were affected very little, if at all on the lower part.

The standard practice in our shops is now to fit the crosshead to a pin ground to the proper taper, and the taper fit on the piston rod to a sleeve. These gages are carefully checked and hardened, and it is thus possible to maintain a standard taper fit both on the piston rod and in the crosshead. As a result of this improvement there has been a marked reduction in failures.

An interesting fracture is shown in Figs. 9, 10 and 11. A close examination of the taper fit on the rod indicated rough filing of the surface. The fatigue cracks started from this rough finish, and to the left of the end of the keyway. The final fracture, however, passed through the keyway, as is clearly disclosed from Figs. 10 and 11, which show the two fractured surfaces, male and female. There may be some question as to whether the cause of the crack was the rough filing of the rod or stress-corrosion. It would appear, however, to be a combination of both of these causes, the file marks aiding the stress-corrosion and concentrating the stresses. Had the finish been smooth and the taper fit correct, the fracture would not have taken place where it did, but farther from the end of the keyway, as in those fractures which were considered in the preceding article of this series in the January, 1937, number. It is worthy of comment, also, that the keyway in question has sharp edges.

Another break in the taper fit of a piston rod is shown in Figs. 12 and 13. Here, again, the surface was filed and the failures can be attributed to a possible combination of fatigue cracks starting in the file marks, and stress-corrosion. This fracture is noteworthy because of the well-developed fatigue crack, the beginnings of which could readily be checked with markings on the finished surface.

Another pronounced case of tool marks which eventually caused the failure of a piston rod in the taper fit is illustrated in Figs. 14 and 15. Here we have the frilled fractured end, indicating that fatigue cracks started in several planes and then joined up as the fractures progressed. In order to give some idea of the way in which the break follows the tool marks on a badly finished piston rod, a greatly enlarged view of the broken end of a rod is shown in Fig. 16.

Fig. 5—Fractured end of a piston rod through the taper fit. Fatigue crack started on the poorly finished surface. The section through the keyway indicates the rough finish of the drilled hole. Fig. 6—Side view of a broken piston rod, fracture of which is shown in Fig. 5. Figs. 7 and 8—Cracks which were started on both sides of the taper fit of a piston rod are shown between the daubs of paint. Note the corrosion band near the larger end of the taper. Figs. 9, 10 and 11—A piston rod broken through the taper fit because of rough filing and stress corrosion. Figs. 10 and 11 show the two fractured surfaces. Fig. 12—Fractured surface of broken piston rod shown in Fig. 13.

Just how far should we carry this campaign against tool marks? It can hardly be said that the entire absence of tool marks would eliminate failures, for it must be recognized that there is a certain amount of work-hardening of the surface, due to its machining. The elimination of the tool marks, however, would undoubtedly insure much longer service. The smoother the surface and the less work-hardening we have in machining the rod, the better. We have a long way to go, however, before we can secure the sort of finishes that are desirable and until we can get the thorough co-operation of all of the mechanics involved. This is a matter of education.

As an example, I reported that a certain job was being done too roughly and that tool marks were quite evident. As a result, the machinist reduced the feed from 70 to 140 per inch. An examination of the finished surface showed that a sharp pointed tool had been used, leaving well-defined tool marks. On the other hand, if the machinist had ground the tool properly and increased the feed to 25 per inch, he would have gotten a much better finished surface. The point is that proper consideration must be given to the grinding of the tool and setting it at the right angles for the grade of steel upon which it is being used.

As an appreciation of the importance of a proper finish

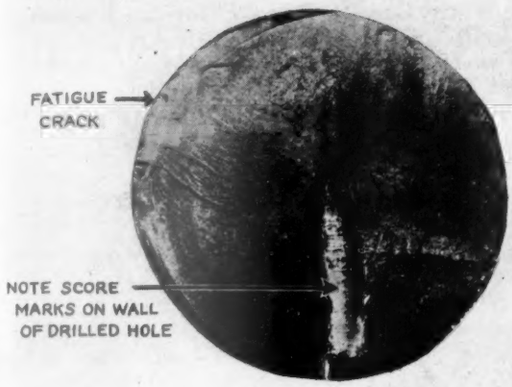


FIG. 5

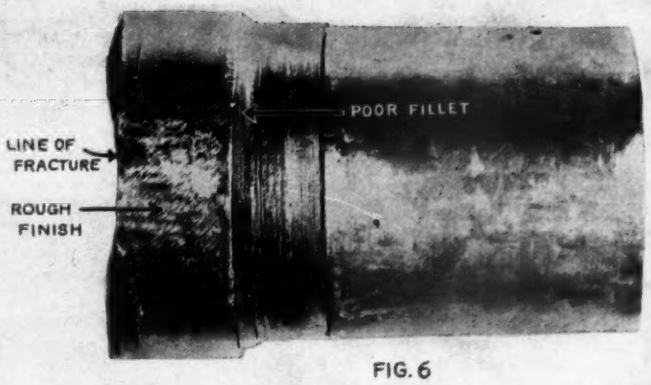


FIG. 6

FIG. 7

FIG. 10

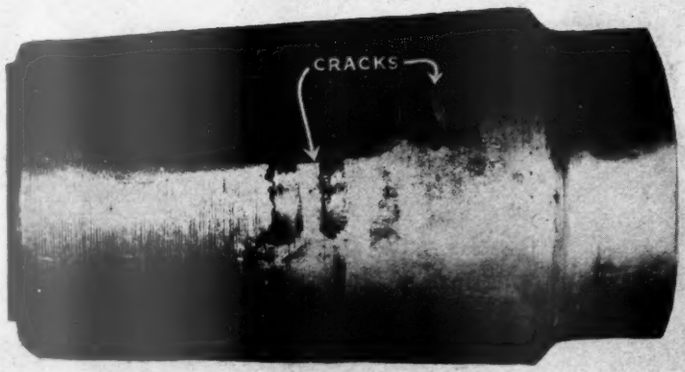


FIG. 8

FIG. 11

FIG. 9

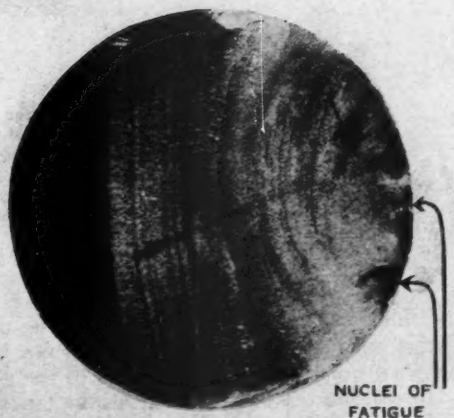


FIG. 12

becomes more general, we find that the average life of piston rods is being lengthened.

Many incidents could be cited indicating that many machinists and shop foremen do not have as full an appreciation as they should of properly machined surfaces.

In the previous article I stressed the importance of undercutting on the taper fit, in order to lengthen the life of the rod. It must be emphasized, however, that the finish of such undercutting must be of the best and that it is worse than useless if it does not have a properly polished finish with smooth fillets of the proper radii.

In making the finishing cut on the taper fit of a piston rod it is necessary to have a proper groundwork or foundation. In other words, the roughing cut must not have badly torn surfaces and must not be too coarse. The importance of this is indicated by the fact that evidence of the roughing cuts can sometimes be seen in the finished surface.

While it may seem a paradox, increased production results from good finishes, although not quite in the terms in which we ordinarily think of it in shop practice. The point is that if the job is rightly done in the first place, the part will remain in service much longer than otherwise. In the long run, therefore, the total amount of work required for a given part is greatly reduced.

It may be difficult to realize, but the fatigue cracks do start from very small and apparently insignificant beginnings. It is said, for instance, that merely touching the surface of a polished test piece with your finger will change the result of the test. How much sooner, then, will a surface badly scored by a tool or file fail to give the service that was intended by the designer?

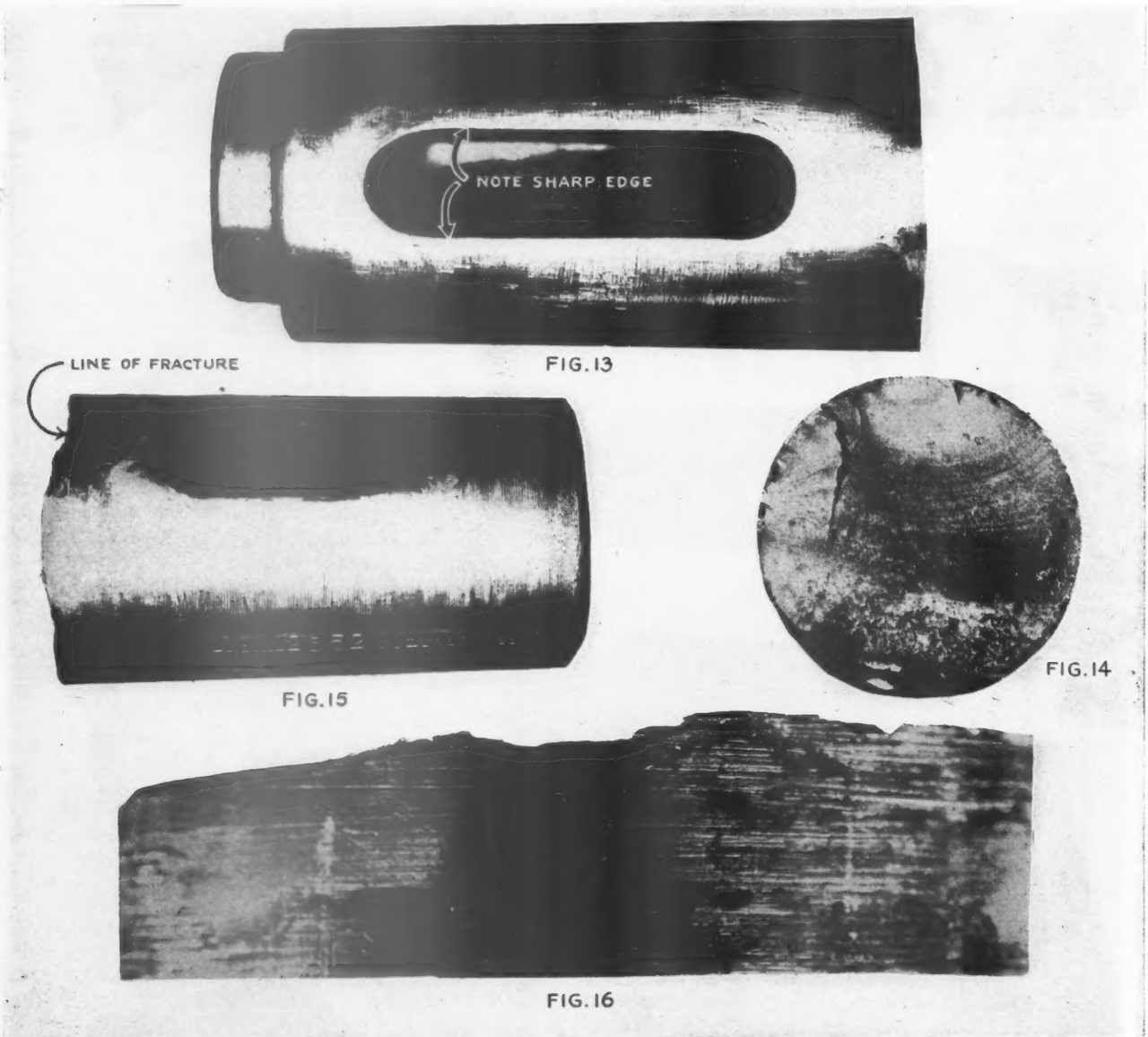


Fig. 13—Piston rod broken through taper fit; apparently caused by a combination of file marks on the finished surface of the taper fit and stress-corrosion. Figs. 14 and 15—Fractured piston rod in which fatigue cracks started from several tool marks, finally joining as the break progressed. Fig. 16—An enlarged view of a broken piston rod, showing how the cracks progressed along the line of the tool marks

Summary Tables of

Diesel Motive Power

ON THIS and the three following pages the *Railway Mechanical Engineer* is presenting, for the first time, a tabulation of the characteristics of the Diesel engines designed for railroad service which are manufactured in the United States, as well as summary tables of the Diesel-powered locomotives, rail cars and streamlined trains in service at the end of the year 1936. The so-called power cars of high-speed light-weight trains, where the body units are devoted exclusively to power plants or auxiliaries and are not permanently connected to the train by articulation are considered to be locomotives and are so listed.

For the sake of consistency present names of engines and engine builders have been used throughout these tables irrespective of the dates on which the engines were installed.

Characteristics of Railroad-Type Diesel Engines

Name of Builder—American Locomotive Company, Diesel Engine Division
General Offices, 30 Church St., New York City. Plant Location, Auburn, N. Y.

Horse-power	Two or four cycle	Cylinders: No.	Arrgt.	Bore and stroke—in.	r.p.m.	Piston speed—f.p.m.	Mean eff. press. lb. per sq. in.	Engine weight—lb.	Wt. per hp.—lb.	Scaveng-ing system	Injec-tion system
300	4	6	Line	9½ x 10½	700	1,225	76	15,000	50	None	C
400	4	6	Line	9½ x 10½	875	1,530	81	15,500	38.8	None	C
600	4	6	Line	12½ x 13	700	1,517	71	35,000	58.4	None	C
660[1]	4	6	Line	12½ x 13	740	1,600	73	27,000	41.0	None	C
900	4	6	Line	12½ x 13	700	1,517	105	38,000	42.2	Supercharged	C
900[1]	4	6	Line	12½ x 13	700	1,517	105	30,000	33.3	Supercharged	C

[1]For rail car service.

Name of Builder—Busch-Sulzer Bros.—Diesel Engine Company
General Offices, St. Louis, Mo. Plant Location, St. Louis, Mo.

Horse-power	Two or four cycle	Cylinders: No.	Arrgt.	Bore and stroke—in.	r.p.m.	Piston speed—f.p.m.	Mean eff. press. lb. per sq. in.	Engine weight—lb.	Wt. per hp.—lb.	Scaveng-ing system	Injec-tion system
1,600	2	8	V	13½ x 16	550	1,430	63.0	39,000	25	Cross	C
2,000	2	10	V	14 x 16	550	1,430	58.5	Approx. 72,000	36	Cross-Roots blower	C

Name of Builder—Cooper-Bessemer Corporation
General Offices, Mt. Vernon, Ohio. Plant Location, Mt. Vernon, Ohio.

Horse-power	Two or four cycle	Cylinders: No.	Arrgt.	Bore and stroke—in.	r.p.m.	Piston speed—f.p.m.	Mean eff. press. lb. per sq. in.	Engine weight—lb.	Wt. per hp.—lb.	Scaveng-ing system	Injection system
250	4	6	Line	8 by 10½	750	1312	85.0	9,800	39.2	None	B[2]
335	4	8	Line	8 by 10½	750	1312	85.0	12,500	37.3	None	B[2]
500	4	6	Line	10½ x 12	750	1500	85.0	21,000	42.0	None	B[2]
660	4	8	Line	10½ x 12	750	1500	85.0	26,000	39.4	None	B[2]

[2]Modified distributor system.

Name of Builder—Cummins Engine Company
General Offices, Columbus, Ind. Plant Location, Columbus, Ind.

Horse-power	Two or four cycle	Cylinders: No.	Arrgt.	Bore and stroke—in.	r.p.m.	Piston speed—f.p.m.	Mean eff. press. lb. per sq. in.	Engine weight—lb.	Wt. per hp.—lb.	Scaveng-ing system	Injection system
100	4	4	Line	4⅞ x 6	1,800	1,800	97.0	1,640	16.4	None	B
125	4	3	Line	7 x 10	1,000	1,670	85.4	4,645	37.1	None	B
140	4	4	Line	6¾ x 9	1,000	1,500	86.3	5,400	38.5	None	B
150	4	6	Line	4⅞ x 6	1,800	1,800	97.0	2,120	14.1	None	B
154	4	4	Line	7 x 9	1,000	1,500	87.8	5,400	35.1	None	B
165	4	4	Line	7 x 10	1,000	1,670	85.4	5,400	32.4	None	B
210	4	6	Line	6¾ x 9	1,000	1,500	86.3	7,075	33.7	None	B
230	4	6	Line	7 x 9	1,000	1,500	87.8	7,075	30.8	None	B
250	4	6	Line	7 x 10	1,000	1,670	85.4	7,075	28.3	None	B
350	4	6	Line	10 x 12	500	1,000	76.0	12,040	40.2	None	B

Name of Builder—De La Vergne Engine Co.
General Offices, Philadelphia, Pa. Plant Location, Eddystone, Pa.

Horse-power	Two or four cycle	Cylinders: No.	Cylinders: Arrgt.	Cylinders: Bore and stroke—in.	r.p.m.	Piston speed—f.p.m.	Mean eff. press. lb. per sq. in.	Engine weight—lb.	Wt. per hp.—lb.	Scaveng-ing system	Injec-tion system
660	4	6	Line	12½ x 15½	600	1,550	76.3	20,600[3]	31.2	None	C

[3]Includes oil pan, air and exhaust headers but no fly-wheel.

Name of Builder—Electro-Motive Corporation (Subsidiary of General Motors)
General Offices, La Grange, Ill. Plant Location, La Grange, Ill.

Horse-power	Two or four cycle	Cylinders: No.	Cylinders: Arrgt.	Cylinders: Bore and stroke—in.	r.p.m.	Piston speed—f.p.m.	Mean eff. press. lb. per sq. in.	Engine weight—lb.	Wt. per hp.—lb.	Scaveng-ing system	Injec-tion system
600	2	8	Line	8 x 10	750	1,250	79.0	13,150	21.9	Through-Roots blower	D
900	2	12	V	8 x 10	750	1,250	79.0	17,900	20.0	Through-Roots blower	D
1,200	2	16	V	8 x 10	750	1,250	79.0	21,550	18.0	Through-Roots blower	D

Name of Builder—Fairbanks-Morse & Co.
General Offices, 900 South Wabash Ave., Chicago. Plant Location, Beloit, Wis.

Horse-power	Two or four cycle	Cylinders: No.	Cylinders: Arrgt.	Cylinders: Bore and stroke—in.	r.p.m.	Piston speed—f.p.m.	Mean eff. press. lb. per sq. in.	Engine weight—lb.	Wt. per hp.—lb.	Scaveng-ing system	Injec-tion system
120	4	6	Line	5½ x 7½	1,200	1,500	74.1	4,424	36.8	None	C
160	4	8	Line	5½ x 7½	1,200	1,500	74.1	5,689	35.5	None	C
300	2	6[4]	Line	5 x 6	1,200	1,200	70.0	9,300	31.0	Cross-through blower	C
400	2	8[4]	Line	5 x 6	1,200	1,200	70.0	10,500	26.3	Cross-through blower	C
750	2	5[4]	Line	8 x 10	720	1,200	82.2	18,850	25.1	Cross-through blower	C
900	2	6[4]	Line	8 x 10	720	1,200	82.2	21,200	23.6	Cross-through blower	C
1,200	2	8[4]	Line	8 x 10	720	1,200	82.2	25,900	21.6	Cross-through blower	C

[4]Opposed piston engine.

Name of Builder—Ingersoll-Rand Co.
General Offices, 11 Broadway, New York, N. Y. Plant Location, Phillipsburg, N. J.

Horse-power	Two or four cycle	Cylinders: No.	Cylinders: Arrgt.	Cylinders: Bore and stroke—in.	r.p.m.	Piston speed—f.p.m.	Mean eff. press. lb. per sq. in.	Engine weight—lb.	Wt. per hp.—lb.	Scaveng-ing system	Injec-tion system
300	4	6	Line	10 x 12	550	1,100	76.0	19,500	65.0	None	C
430	4	6	Line	10 x 12	750	1,500	80.2	16,500	38.4	None	C
575	4	8	Line	10 x 12	750	1,500	80.5	22,000	38.2	None	C
900	4	6	Line	14¾ x 16	550	1,470	79.0	38,500	38.9	None	C

Name of Builder—Westinghouse Electric & Manufacturing Company
General Offices, Philadelphia, Pa. Plant Location, S. Philadelphia (Lester), Pa.

Horse-power	Two or four cycle	Cylinders: No.	Cylinders: Arrgt.	Cylinders: Bore and stroke—in.	r.p.m.	Piston speed—f.p.m.	Mean eff. press. lb. per sq. in.	Engine weight—lb.	Wt. per hp.—lb.	Scaveng-ing system	Injec-tion system
265	4	4	Line	9 x 12	900	1,800	76.5	10,255[5]	38.7	None	C
400	4	6	Line	9 x 12	900	1,800	76.5	12,220[5]	30.5	None	C
530	4	6	Line	9 x 12	900	1,800	102.0	14,600[5,6]	27.6	See note [7]	C
800	4	12	V	9 x 12	900	1,800	76.5	24,800[5]	31.0	None	C
1,060	4	12	V	9 x 12	900	1,800	102.0	27,000[5,6]	25.5	See note [7]	C

[5]Includes flywheel, bedplate, muffler, intake strainers.
[6]Includes air intake silencers.
[7]Supercharged by Roots blower.

Injection systems:
A—Common rail
B—Distributor
C—Individual fuel pump
D—Unit injector

Diesel-Electric Locomotives in the United States and Canada

Railroad	No. of units	Wheel arrgt.	Service	Name of builder of Locomotive	Engine	Elec. equip.	Engines No.	Engines h.p. each	Total weight lb.	Date in service
A. T. & S. F.	1	0-4-4-0	Pass.	Electro-Motive St. Louis Car	E. M. C.	Gen. Elec.	2	900	258,400	1935
	1	0-4-4-0	Pass.	Electro-Motive St. Louis Car	E. M. C.	Gen. Elec.	2	900	258,400	1935
	1	0-4-4-0	Switch.	Alco	Alco	Gen. Elec.	1	600	203,000	1935
	1	0-4-4-0	Switch.	Electro-Motive	E. M. C.	Gen. Elec.	1	600	194,700	1936
B. & O.	1	0-4-4-0	Switch.	Alco	Ing.-Rand	Gen. Elec.	1	300	120,000	1925
	1	0-4-4-0	Pass.	Electro-Motive & Gen. Elec.	E. M. C.	Gen. Elec.	2	900	259,000	1935
Belt Ry. of Chicago	1	0-4-4-0	Switch.	Gen. Elec.	Ing.-Rand	Gen. Elec.	2	300	216,000	1934
	1	0-4-4-0	Switch.	Alco	Alco	Gen. Elec.	1	600	203,000	1934
	1	0-4-4-0	Switch.	Alco	Alco	Gen. Elec.	1	600	203,000	1935
	1	0-4-4-0	Switch.	Alco	Alco	Gen. Elec.	1	600	199,000	1935
Boston & Maine	1	0-4-4-0	Switch.	Alco	Alco	Gen. Elec.	1	600	197,500	1934
	1	0-4-4-0	Switch.	Gen. Elec.	Ing.-Rand	Gen. Elec.	2	300	208,672	1934
	3	0-4-4-0	Switch.	Electro-Motive	E. M. C.	Gen. Elec.	1	600	197,580	1936
(Portland Term.)	3	0-4-4-0	Switch.	Alco	Alco	Gen. Elec.	1	600	196,000	1936
Bush Terminal	7	0-4-4-0	Switch.	Gen. Elec.	Ing.-Rand	Gen. Elec.	1	300	117,000	1931
Canadian National	2	4-8-4	Pass.	Can. Loco. Wks.	Beardmore	West.		1,330	334,000	1929
	1	0-4-4-0	Switch.	Can. Loco. Wks.	West.	West.	1	400	140,000	1930
	1	0-4-4-0	Switch.	R. R. Co.	Ing.-Rand	Gen. Elec.	2	300	234,000	1932
Central Railroad of New Jersey	1	0-4-4-0	Switch.	Alco	Ing.-Rand	Gen. Elec.	1	300	120,000	1925
Cheswick & Harmer	1	0-4-4-0	Switch.	Baldwin	West.	West.	2	265	130,000	1933
Chicago & North Western	2	0-4-4-0	Switch.	Alco	Ing.-Rand	Gen. Elec.	1	300	130,000	1926
	1	0-4-4-0	Switch.	Alco	Ing.-Rand	Gen. Elec.	1	300	130,000	1927
	1	0-4-4-0	Switch.	Gen. Elec.	Ing.-Rand	Gen. Elec.	2	300	216,000	1930
Chicago, Burlington & Quincy	3	0-4-4-0	Switch.	Midwest	Cummins	Gen. Elec.	2	250	130,000	1933-34
	2	[1]	Pass.	Electro-Motive	E. M. C.	Gen. Elec	2 1	900 1200	426,000	1936
	2	0-4-4-0	Pass.	Electro-Motive	E. M. C.	Gen. Elec.	2	900	222,520	1936
Chicago Great Western	1	0-4-4-0	Switch.	Baldwin	West.	West.	1	800	228,400	1934
	2	0-4-4-0	Switch.	Bethlehem	West.	West.	2	400	230,000	1936
	3	0-4-4-0	Switch.	Electro-Motive	E. M. C.	Gen. Elec.	1	600	200,000	1936
Chicago, Rock Island & Pacific	1	0-4-4-0	Switch.	Gen. Elec.	Ing.-Rand	Gen. Elec.	1	300	256,000	1930[4]
Delaware, Lackawanna & Western	1	0-4-4-0	Switch.	Alco	Ing.-Rand	Gen. Elec.	1	300	132,700	1926
	2	0-4-4-0	Switch.	Gen. Elec.	Ing.-Rand	Gen. Elec.	1	300	248,000	1930[2]
	2	0-4-4-0	Switch.	Gen. Elec.	E. M. C.	Gen. Elec.	1	600	204,150	1935
	8	0-4-4-0	Switch.	Alco	Alco	Gen. Elec.	1	600	204,000	1933-34
	6	0-4-4-0	Switch.	Gen. Elec.	Ing.-Rand	Gen. Elec.	2	300	204,000	1933-34
Erie	1	0-4-4-0	Switch.	Alco	Ing.-Rand	Gen. Elec.	1	300	130,000	1926
	2	0-4-4-0	Switch.	Alco	Ing.-Rand	Gen. Elec.	2	300	233,000	1927
	1	0-4-4-0	Switch.	Alco	Ing.-Rand	Gen. Elec.	1	300	130,000	1928
	1	0-4-4-0	Switch.	Gen. Elec.	Ing.-Rand	Gen. Elec.	1	800	230,000	1931
Great Northern	1	0-4-4-0	Mixed	Alco	Ing.-Rand	Gen. Elec.	2	300	209,500	1926
Harlem Transfer (N. Y. City)	1	0-4-4-0	Switch.	Alco	Ing.-Rand	Gen. Elec.	1	300	132,700	1926
Hoboken Manufacturer's Railroad	1	0-4-4-0	Switch.	Gen. Elec.	Ing.-Rand	Gen. Elec.	1	300	144,000	1928
	1	0-4-4-0	Switch.	Gen. Elec.	Ing.-Rand	Gen. Elec.	2	300	220,000	1928
Illinois Central	1	0-4-4-0	Switch.	Alco	Ing.-Rand	Gen. Elec.	2	300	215,650	1929
	5	0-4-4-0	Switch.	Gen. Elec.	Ing.-Rand	Gen. Elec.	2	300	215,650	1930
	8	0-4-4-0	Switch.	Alco	Alco	West.	1	600	198,000	1934
	1	0-6-6-0	Switch.	Gen. Elec.	Ing.-Rand	Gen. Elec.	2	900	342,000	1936
	1	0-6-6-0	Switch.	Gen. Elec.	Busch-Sulzer	Gen. Elec.	1	2,000	346,000	1936
	1	4-4-4-4	Switch.	St. Louis Car	E. M. C.	Gen. Elec.	2	900	324,000	1936
Jay St. Terminal (N. Y. City)	1	0-4-4-0	Switch.	Alco	Alco	Gen. Elec.	1	300	120,000	1931
Lehigh Valley	1	0-4-4-0	Switch.	Alco	Ing.-Rand	Gen. Elec.	1	300	123,000	1926
	1	0-4-4-0	Switch.	Brill	Alco	Gen. Elec.	1	300	142,500	1927
	2	0-4-4-0	Switch.	Alco	Alco	Gen. Elec.	1	300	132,000	1931
	1	0-4-4-0	Switch.	Alco	Alco	Gen. Elec.	1	600	202,000	1932
	1	0-4-4-0	Switch.	Alco	Ing.-Rand	Gen. Elec.	1	300	127,580	1932
Long Island	1	0-4-4-0	Switch.	Alco	Ing.-Rand	Gen. Elec.	2	300	203,300	1925
	1	0-4-4-0	Switch.	Alco	Ing.-Rand	Gen. Elec.	2	300	218,000	1928
	1	0-4-4-0	Switch.	Baldwin	West.	West.	2	300	174,000	1928
Midland Continental	1	0-4-4-0	Road	Baldwin	West.	West.	2	265	144,000	1934
Missouri Southern	1	0-4-4-0	Switch. and local freight	Plymouth	Cummins	West.	2	250	130,000	1934
New York Central System	1	4-8-4	Switch.	Alco	Ing.-Rand	Gen. Elec.	1	750	300,000	1928
	1	0-4-4-0	Switch.	Alco	Ing.-Rand	Gen. Elec.	1	300	257,000	1928[3]
	37	0-4-4-0	Switch.	Gen. Elec.	Ing.-Rand	Gen. Elec.	1	300	256,000	1930[3]
	4	0-4-4-0	Switch.	Gen. Elec.	Ing.-Rand	Gen. Elec.	1	300	256,000	1930[3]
	1	0-4-4-0	Switch.	Gen. Elec.	Buda	Gen. Elec.	1	90	90,000	1933[4]
	7	0-4-4-0	Switch.	Electro-Motive	E. M. C.	Gen. Elec.	1	600	200,000	1936
New York, New Haven & Hartford	1	0-4-4-0	Switch.	Alco	Alco	Gen. Elec.	1	600	200,000	1932
	5	0-4-4-0	Switch.	Gen. Elec.	Ing.-Rand	Gen. Elec.	1	600	195,000	1936
	5	0-4-4-0	Switch.	Gen. Elec.	Cooper-Bessemer	Gen. Elec.	1	660	196,000	1936
Northampton & Bath	1	0-4-4-0	Switch. and terminal	Baldwin	West.	West.	2	400	220,000	1932
	1	0-4-4-0	Switch. and terminal	Baldwin	West.	West.	2	400	220,000	1934
Peoria & Pekin Union	1	0-4-4-0	Switch.	Alco	Alco	Gen. Elec.	1	600	199,000	1936
Phila. Beth. and N. E.	1	0-4-4-0	Switch.	Bethlehem	E. M. C.	West	1	900	204,000	1935
	1	0-4-4-0	Switch.	Gen. Elec.	Buda	West	1	150	130,000	1933[4]
Reading	1	0-4-4-0	Switch.	Alco	Ing.-Rand	Gen. Elec.	1	300	130,000	1926
	1	0-4-4-0	Switch.	Alco	Ing.-Rand	Gen. Elec.	1	300	133,900	1928
South Buffalo Ry.	2	0-4-4-0	Switch.	Electro-Motive	E. M. C.	Gen. Elec.	1	600	200,000	1936
Union Pacific	1[1]	[1]	Pass.	Pull.-Std.	E.M.C.	Gen. Elec.	1 1	900 1,200	334,440	1936
	1[1]	[1]	Pass.	Pull.-Std.	E. M. C.	Gen. Elec.	2	1,200	391,390	1936
	2[1]	[1]	Pass.	Pull.-Std.	E. M. C.	Gen. Elec.	2	1,200	390,050	1936
	1[1]	[1]	Pass.	Pull.-Std.	E. M. C.	Gen. Elec.	2	1,200	430,000	1936

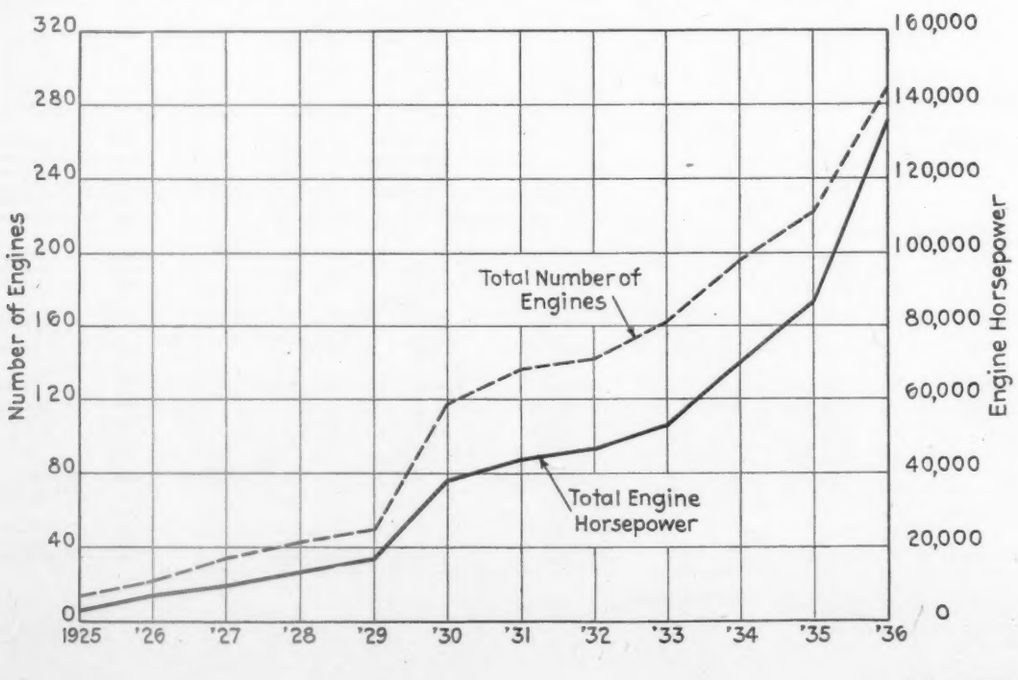
Notes:
[1] Two unit locomotive, each unit having two four-wheel trucks.
[2] Oil-electric battery 3,000-volt trolley.
[3] Oil-electric-battery 600-volt third rail.
[4] Oil-electric-battery.

Diesel-Electric Rail Cars and Trains in the U. S. and Canada

Railroad	Year ordered	Name of train	No. of cars	No. of trains	No. of body units each train	Builder of: Train or car	Engine	Elec. equip.	Engines: No.	Hp. each	Total weight, lb.
Boston & Maine	1934	Flying Yankee	..	1	3 artic.	Budd	E.-M. C.	Gen. Elec.	1	600	218,917
	1934	.....	1	..	.....	St. Louis Car	Ing.-Rand	Gen. Elec.	2	400	221,000
	1934	.....	1	..	.....	St. Louis Car	West.	West.	1	950	221,700
Maine Central	1935	.....	1	..	.....	St. Louis Car	Ing.-Rand	Gen. Elec.	2	300	218,000
Canadian National	1924	.....	7	..	.....	Ottawa Car Co. R. R. Co.	Beardmore	English Elec.	1	200	102,000
	1924	.....	..	1	2 artic.	Ottawa Car Co. R. R. Co.	Beardmore	West.	1	400	188,000
	1926	.....	5	..	.....	C. C. & F. R. R. Co.	Beardmore	West.	1	300	141,000
	1928	.....	1	..	.....	Nat'l. Steel	Beardmore	English Elec.	1	200	100,000
	1929	.....	7	..	.....	C. C. & F.	West.	West.	1	350	142,000
	1930	.....	2	..	.....	Nat'l. Steel	West.	West.	1	350	144,000
	1930	.....	4	..	.....	Nat'l. Steel R. R. Co.	Beardmore	West.	1	300	141,000
Chicago, Burlington & Quincy	1933	Zephyr	..	1	4 artic. [1]	Budd	E.-M. C.	Gen. Elec.	1	600	266,000 [1]
	1934	Twin Zephyrs	..	2	3 artic.	Budd	E.-M. C.	Gen. Elec.	1	600	225,000
	1935	Mark Twain Zephyr	..	1	4 artic.	Budd	E.-M. C.	Gen. Elec.	1	600	290,000
Erie	1929	.....	1	..	.....	St. Louis Car	West.	West.	2	300	206,808
Great Northern	1930	.....	1	..	.....	St. Louis Car	West.	West.	1	400	147,780
	1933	.....	1	..	.....	Std. Steel	West.	West.	1	400	161,700
Gulf, Mobile & Northern	1934	Rebel	..	2	3 non-artic. (including power unit) [2]	A. C. F.	Alco	West.	1	660	373,200 [5]
Illinois Central	1934	Green Diamond	..	1	5 artic.	Pull.-Std.	E.-M. C.	Gen. Elec.	1	1,200	543,400
New York, New Haven & Hartford	1934	Comet	..	1	3 artic.	Good.-Zepp.	West.	West.	2	400	260,590
Pennsylvania	1928	.....	2	..	.....	Pull.-Std.	West.	West.	1	330	133,475
Reading	1929	.....	1	..	.....	Bethlehem	West.	West.	1	300	138,400
	1929	.....	1	..	.....	Bethlehem	West.	West.	1	300	137,300
	1932	.....	1	..	.....	Budd	Cummins	West.	1	125	23,400
Seaboard Air Line	1935	.....	2	..	.....	St. Louis Car	E.-M. C.	Gen. Elec.	1	600	156,126
	Note [3]	.....	2	..	.....	A. C. F.-Brill	West.	West.	1	265	128,050
	Note [3]	.....	1	..	.....	A. C. F.-Brill	West.	West.	1	265	117,000
Union Pacific	1933	City of Portland	..	1	7 artic. [4]	Pull.-Std.	E.-M. C.	Gen. Elec.	1	900	592,000 [5]

[1] Four body units. Originally built as three body units weighing 219,000 lb.
[2] A seventh car provided for interchangeable service. Weight includes power car and two trailers.
[3] Cars originally built in 1927 as gas-electric; Diesel engines installed in 1936.
[4] Originally six body units; one added, June, 1935.
[5] Weight of seven-car train.

Diesel Engines in Locomotives, Rail Cars and Streamline Trains in the U. S. and Canada



First Sizable

Equipment Market Since 1930

Locomotive and freight-car orders in 1936 were the largest since 1929, although passenger-car orders during the past year were exceeded in 1934 and 1930. Light-weight high-speed trains were an important factor in last year's business

ORDERS for motive power and rolling stock placed in the United States during 1936 showed a big increase over those placed during the preceding year. The 533 locomotives constitute the largest number of orders placed since 1929 when 1,212 were ordered in the United States. The orders for 67,544 freight cars have not been exceeded since 1930 and are nearly 17 per cent more than total number ordered during the preceding five years. In the case of passenger cars, although the 307 ordered in 1936 marked a big increase over 1935, they did not equal the number ordered in 1934 or in 1930.

Table I — Orders for Locomotives of All Types Since 1918

Year	Domestic	Canadian	U. S. Export	Total
1918	2,593	209	2,086	4,888
1919	214	58	898	1,170
1920	1,998	189	718	2,905
1921	239	35	546	820
1922	2,600	68	131	2,799
1923	1,944	82	116	2,142
1924	1,413	71	142	1,626
1925	1,055	10	209	1,274
1926	1,301	61	180	1,542
1927	734	58	54	846
1928	603	98	27	728
1929	1,212	77	106	1,395
1930	440	95	20	555
1931	176	2	28	206
1932	12	1 (Export)	1	14
1933	42	...	7	49
1934	182	...	17	199
1935	83	27	15	125
1936	533	1	22	556

Unlike the situation in the United States the Canadian orders were relatively small. Only one locomotive was ordered for service in Canada. The 271 freight cars ordered for service in Canada compare with 2,421 for which orders were placed in 1935, and the 10 passenger-car orders were also exceeded by the 16 during the preceding year.

Locomotive Orders

In Table II is shown a classification, by types, of the locomotives ordered during 1936. Of the 498 locomotives ordered for railway service, 110 are of the 4-8-4 type, 66 of the 4-6-4 type, 62 of the 0-8-0 type, and 61 Diesel-electric locomotives. This indicates clearly the increase in the demand for the 4-8-4 type for high-capacity passenger service and fast freight service. The table also brings out clearly the renewed popularity of the articulated types to meet the demand for expedited schedules in freight service over difficult lines. Orders for a total of 97 articulated locomotives, with five types of wheel arrangement, were placed last year. These are all single-expansion locomotives.

Table II — Types and Number of Steam Locomotives Ordered in 1936

Type	Railroad U. S. and Canada	Industrial service	Export	Total
0-4-0	...	2	1	3
0-6-0	7	5	..	12
0-8-0	62	..	..	62
0-10-2	9	..	..	9
2-8-0	...	..	5	5
2-8-2	13	..	5	18
2-10-2	...	..	1	1
2-8-4	10	..	..	10
2-10-4	40	..	..	40
4-4-2	2	..	..	2
4-6-2	5	1	3	9
4-6-4	66	..	..	66
4-8-2	5	..	..	5
4-8-4	110	..	..	110
2-6-6-2	...	..	2	2
2-6-6-4	17	..	..	17
2-8-8-2	9	..	..	9
4-4-4-4	1	..	..	1
4-6-6-4	44	..	..	44
4-8-8-2	26	..	..	26
Electric	10	14	5	29
Diesel-elec.	61	14	..	75
Steam turbo-elec.	1	..	..	1
Total	498	36	22	556

Among the large orders placed during the year were 50 4-6-4 type for the New York Central and 50 0-8-0 type for the Pittsburgh & Lake Erie. The Chicago, Milwaukee, St. Paul and Pacific ordered 30 4-8-4 type locomotives for freight service, and the Union Pacific 20 4-8-4 type locomotives for passenger service. Numerous orders for 10 or more locomotives of a single type were also placed by other railroads.

Of the 61 Diesel-electric locomotives for which orders were placed during the year 15 were for road passenger service, six of 1,200 hp. capacity, three of 3,600 hp., two of 5,400 hp., two of 3,000 hp., and two of 1,800 hp. The others are from 600 to 1,000 hp. capacity. A number of smaller capacity locomotives were ordered for industrial service. Among these were several gas-electric, one gasoline and one propane-electric locomotive. With the exception of one electric locomotive for freight service, ordered by the Pennsylvania, the electric locomotives were ordered for industrial or terminal service.

Table III — Orders for Freight Cars Since 1918

Year	Domestic	Canadian	Export	Total
1918	114,113	9,657	53,547	177,317
1919	22,062	3,837	3,994	29,893
1920	84,207	12,406	9,056	105,669
1921	23,346	30	4,982	28,358
1922	180,154	746	1,072	181,972
1923	94,471	8,685	396	103,552
1924	143,728	1,867	4,017	149,612
1925	92,816	642	2,138	95,596
1926	67,029	1,495	1,971	70,495
1927	72,006	2,133	646	74,785
1928	51,200	8,901	2,530	62,631
1929	111,218	9,899	3,023	124,140
1930	46,360	1,936	1,200	49,496
1931	10,880	3,807	151	14,838
1932	1,968	501	77	2,546
1933	1,685	75	132	1,892
1934	24,611	12	1,323	25,946
1935	18,699	2,421	110	21,230
1936	67,544	271	526	68,341

Freight-Car Orders

The number of freight cars ordered annually since 1918 is shown in Table III. Of the total of 68,341 cars ordered in the United States and Canada, 67,544 were

Table IV — Class and Number of Freight Cars Ordered in 1936

Class	United States and Canada			Export
	Railroads	Private	Total	
F—Flat	1,224	15	1,239	..
G—Gondola	10,039	475	10,514	..
H—Hopper	18,348	179	18,527	..
HR—Covered hopper	11	50	61	..
R—Refrigerator	1,000	6,397	7,397	..
T—Tank	2	4,010	4,012	16
X—Box	18,367	..	18,367	500
XA—Auto. box	4,695	..	4,695	..
S—Stock	400	..	400	..
N—Caboose	123	..	123	..
Not classified	2,430	50	2,480	10
Total	56,639	11,176	67,815	526

for service in the United States. This may again be subdivided into 56,639 ordered by railroads and 11,176 ordered by private car lines or other non-carrier owners. Almost equal numbers of hopper and box cars were ordered, and these two classes combined constitute approximately 65 per cent of the total number of cars ordered by the railroads. Only two of the 4,012 tank cars ordered during the year were on railroad account, while 1,000 refrigerator cars were ordered by railroads and 6,397 by private car lines.

Among the large orders for freight cars were those placed by the Chesapeake & Ohio for 7,350, of which 4,000 are hoppers; the Norfolk & Western for 6,100, of which 4,500 are hoppers; the Southern Pacific for 4,975, of which 1,750 are double-sheathed box cars; the Chicago, Burlington & Quincy for 4,800, and the Atchison, Topeka & Santa Fe for 3,585. Of the 67,544 cars ordered for domestic service in the United States, 14,290 —about 21 per cent—were placed with company shops by 27 railroads or private car lines. Included are private car lines who regularly build part or all of their own equipment.

Table V — Orders for Passenger Train Cars Since 1918

Year	Domestic	Canadian	Export	Total
1918	9	22	26	57
1919	292	347	143	782
1920	1,781	275	38	2,094
1921	246	91	155	492
1922	2,382	87	19	2,488
1923	2,214	263	6	2,483
1924	2,554	100	25	2,679
1925	2,191	50	76	2,317
1926	1,868	236	58	2,162
1927	1,612	143	48	1,803
1928	1,930	334	29	2,293
1929	2,303	122	33	2,458
1930	667	203	15	885
1931	11	11	21	43
1932	39	..	..	39
1933	6	..	..	6
1934	388	..	15	403
1935	63	16	..	79
1936	*307	10	..	*317

* Includes 102 body units of articulated or partially articulated trains.

Passenger-Car Orders

While the 307 passenger cars ordered during 1936 was more than three times the number placed during the preceding year, it was still less than the number ordered in 1934. Included in the 307 cars are 102 body units of articulated or partially articulated trains. The largest orders were placed by the New York, New Haven & Hartford and the Union Pacific, each constituting 50 units; those of the New Haven all were coaches while the Union Pacific order was for 40 coaches and five articulated diners consisting of five dining-room body units and five kitchen body units. The latter road also shared in the order for two 14-car trains of partially articulated equipment with the Southern Pacific and the Chicago & North Western.

The order placed with its own shop for 37 passenger cars, constituting coaches, mail, express, parlor, dining and tap-room equipment, also numbers the Chicago Milwaukee, St. Paul & Pacific among the roads placing outstanding orders during the year.

Annual Report of the

Bureau of Locomotive Inspection

Twenty-fifth annual report shows an increase in accidents but a decrease in the number of employes killed and injured.

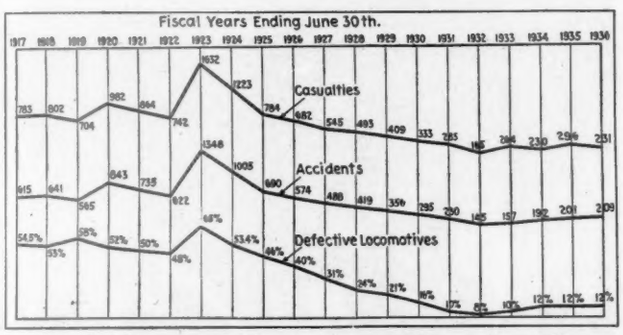
THE annual report of John M. Hall, chief inspector, Bureau of Locomotive Inspection, to the Interstate Commerce Commission, marks the completion of a quarter of a century of federal control of locomotive inspection. This twenty-fifth annual report shows the improvement in the condition of steam locomotives and deaths and accidents resulting therefrom since February 11, 1911, when the Locomotive Boiler Inspection Act became obligatory upon the carriers. Although authentic records do not show the number of casualties caused by defective boilers and their appurtenances prior to the passage of the act, the first annual report in 1912 showed that 91 persons were killed and 1,005 were injured in accidents involving locomotive boilers. As a result of federal inspection the number of persons killed and injured were reduced to 10 and 80, respectively, in 1936. In 1917 the act was amended to include the entire locomotive and tender, and was amended later to include all locomotives regardless of the source of power. During the period from 1912 to 1936 there were 717 persons killed and 8,771 injured as a result of failures of locomotive boilers and their appurtenances. It is interesting to note that if the casualties had occurred at the same rate throughout this period as they occurred during the first year in which the act was effective there would have been 2,275 persons killed and 27,125 injured.

Steam Locomotives

The total number of steam locomotives inspected by the bureau during the past fiscal year ending June 30, 1936, was 97,329, of which 11,526 or 12 per cent were found defective. This compares with 11,071 defective locomotives in the year ending June 30, 1935, and 10,713 in 1934. The number of locomotives ordered out of service in 1936, 1935, and 1934 were 852, 921, and 754, respectively, which figures compare with the low of 527 in 1932. The locomotives ordered out of service in 1936 represent a reduction of 7.5 per cent under the number ordered out of service in 1935.

The number of defects found in 1936 totaled 47,453, which compares with 44,491 in 1935 and 43,271 in 1934.

The number of defects in 1936 represents an increase of approximately 7 per cent over 1935. A total of 209 accidents were reported in 1936 as against 201 in 1935, an increase of 4 per cent. However, the number of persons killed fell to 16 in 1936 from 29 in 1935, a decrease of 44.8 per cent, whereas the 29 killed in 1935 was an increase of 21 or 314.3 per cent over 1934. The number of persons injured in 1936 totaled 215, as against 267 in 1935, and 223 in 1934. The 1936 total represents a decrease of 19.5 per cent from the number in 1935. The total of 231 casualties in 1936, when there were 209 accidents, compares with the low of 165 casualties in 1932, when there were 145 accidents. Compared with the first year in which the Boiler Inspection Act was effective, the 1936 report shows a reduction of 96 per cent in the number of accidents, a reduction of 89 per cent in the number



Relation of defective steam locomotives to accidents and casualties resulting from locomotive failures

of persons killed, and a reduction of 92 per cent in the number of persons injured.

During the year 12 per cent of the steam locomotives inspected were found with defects or errors that should have been corrected before the locomotives were placed in service as compared with only 8 per cent in 1932. As noted previously there was an increase of 7.5 per cent in the number of locomotives ordered out of service and an increase of 7 per cent in the number of defects found. A comparison of the number of defects found over a six-year period together with the itemization of these defects is shown in one of the tables.

Boiler Explosion

Boiler explosions caused by crown sheet failures continue to be the source of most of the fatal accidents. There was a decrease of three accidents, a decrease of 13 in the number of persons killed, and a decrease of 52 in the number of persons injured from this cause, as compared with the previous year. Eight persons were killed in such failures; this represents 50 per cent of all fatalities that occurred during the year. Eight persons were injured in accidents caused by crown-sheet failures; this represents 3.7 per cent of all injuries that occurred during the year.

Other boiler and appurtenance accidents, including the failure of a side sheet due to overheating caused by negligence in not washing the boiler as often as water conditions required, resulted in the death of two persons and the injury of 72 persons.

Extension of Time for Removal of Flues

Applications for extensions of time for removal of flues as provided for in Rule 10 totaled 1,115. Of these 92 were rejected, 75 were given extensions for a shorter time than requested, 124 were granted after defects found were repaired, 28 requests were cancelled, and 796 extensions were granted for the full periods requested.

Other Types of Locomotives

In 1936 there were 3,118 locomotives other than steam inspected of which 252, or 8 per cent, were found defective, and 11 ordered out of service. This compares with

Condition of Locomotives Found by Inspection in Relation to Accidents and Casualties*

Fiscal year ended June 30	Per cent of locomotives inspected found defective	Number of locomotives ordered out of service	Number of accidents	Number of persons killed	Number of persons injured
1912	65.7	3,377	856	91	1,005
1915	44.4	2,027	425	13	467
1925	46	3,637	690	20	764
1926	40	3,281	574	22	660
1927	31	2,539	488	28	517
1928	24	1,725	419	30	463
1929	21	1,490	356	19	390
1930	16	1,200	295	13	320
1931	10	688	230	16	269
1932	8	527	145	9	156
1933	10	544	157	8	256
1934	12	754	192	7	223
1935	12	921	201	29	267
1936	12	852	209	16	215

* The original act applied only to the locomotive boiler.

1,620 units inspected in 1935 of which 146, or 9 per cent, were found defective and five were ordered out of service. The number of casualties resulting from accidents involving locomotives other than steam was nine in 1936, eight in 1935 and one in 1934. No deaths due to defective equipment have occurred in the past six years.

Changes or modifications in some of the rules for inspection and testing of locomotives other than steam became effective on May 1, 1936. These changes were designed to clarify the applicability of certain rules to the various types of heating equipment involved and to reduce the fire hazard incident to the use of liquid fuels, particularly the fuels used in internal-combustion engines.

Special hazards accompany the use of equipment driven by internal-combustion engines due to the volatil-

Front-end steam pipe that failed while the locomotive was hauling a passenger train at a speed of approximately 45 m.p.h.

ity and inflammability of the liquid fuels. There were eight fires from this case recorded in the past year; four of the fires caused personal injuries, but all may have resulted in major disasters had it not been for fortunate circumstances.

The principal causes of these fires are overflowing through fuel-reservoir vent pipes or carburetors when the reservoirs are being filled due to lack of proper means to indicate the height of fuel in the reservoirs or to inattention on the part of persons performing the filling operation, flooding of carburetors when the engines are in operation, and inability to control the engine speed due to unsuitable throttle mechanism or defective speed governors.

The report states: "If fires are to be avoided, it is incumbent upon the carriers to see that all practical mechanical safeguards are provided and maintained in good operating condition, and that all who are charged with the duty of filling the reservoirs be fully informed as to the proper and safe procedure and the results that may accrue through inattention or carelessness."

Number of Steam Locomotives Reported, Inspected, Found Defective, and Ordered from Service

Parts defective, inoperative or missing or in violation of rules	Year ended June 30—					
	1936	1935	1934	1933	1932	1931
1. Air compressors	740	733	660	474	417	481
2. Arch tubes	74	74	127	51	54	60
3. Ash pans & mechanism	79	94	87	40	69	81
4. Axles	13	10	6	21	13	10
5. Blow-off cocks	236	283	289	210	144	191
6. Boiler checks	356	413	407	293	214	263
7. Boiler shell	383	395	372	296	220	430
8. Brake equipment	2,480	2,449	2,326	1,696	1,645	1,923
9. Cabs, cab windows and curtains	1,638	1,273	1,342	1,183	851	1,484
10. Cab aprons and decks	450	368	343	309	262	415
11. Cab cards	166	142	129	121	162	211
12. Coupling and uncoupling devices	65	73	54	67	85	98
13. Crossheads, guides, pistons, and piston rods	1,056	1,086	1,100	773	763	856
14. Crown bolts	63	75	77	67	50	96
15. Cylinders, saddles, and steam chests	1,717	1,547	1,491	1,084	841	1,265
16. Cylinder cocks and rigging	605	627	654	374	376	411
17. Domes and dome caps	114	94	105	76	45	83
18. Draft gear	513	423	401	318	325	568
19. Draw gear	451	414	480	357	371	640
20. Driving boxes, shoes, wedges, pedestals, and braces	1,712	1,573	1,472	1,080	821	925
21. Firebox sheets	295	343	356	246	235	341
22. Flues	178	173	203	150	120	187
23. Frames, tailpieces, and braces, locomotive	997	1,006	951	669	611	740
24. Frames, tender	113	124	128	80	86	105
25. Gages and gage fittings, air	257	275	212	145	156	192
26. Gages and gage fittings, steam	350	320	289	258	214	324
27. Gage cocks	579	480	384	388	330	415
28. Grate shakers and fire doors	400	394	404	245	288	410
29. Handholds	502	464	377	363	382	562
30. Injectors, inoperative	40	39	33	20	31	55
31. Injectors and connections	2,085	2,035	1,909	1,357	1,168	1,815
32. Inspections and tests not made as required	9,005	8,344	8,173	6,358	3,801	4,862
33. Lateral motion	404	389	351	269	237	289
34. Lights, cab and classification	78	81	79	76	55	77
35. Lights, headlights	251	257	218	169	119	180
36. Lubricators and shields	255	191	215	157	119	176
37. Mud rings	237	241	247	232	166	318
38. Packing nuts	508	527	491	419	402	523
39. Packing, piston rod and valve stem	1,133	906	833	592	444	706
40. Pilot and pilot beams	178	152	174	123	145	160
41. Plugs and studs	236	167	242	151	176	182
42. Reversing gear	463	414	390	254	202	299
43. Rods, main and side, crank pins, and collars	2,093	1,826	1,670	1,327	1,256	1,520
44. Safety valves	125	100	103	53	63	61
45. Sanders	678	779	697	376	289	314
46. Springs and spring rigging	3,008	2,765	2,854	2,122	1,851	2,161
47. Squirt hose	134	113	107	93	96	184
48. Stay bolts	279	140	285	219	181	293
49. Stay bolts, broken	520	512	455	368	552	938
50. Steam pipes	526	463	489	338	285	512
51. Steam valves	227	212	267	193	143	226
52. Steps	615	640	567	498	622	676
53. Tanks and tank valves	877	913	862	600	587	732
54. Telltale holes	127	102	93	90	108	151
55. Throttles and throttle rigging	760	733	639	448	434	574
56. Trucks, engine and trailing	861	811	898	664	648	714
57. Trucks, tender	1,108	1,120	918	747	766	1,059
58. Valve motion	824	799	784	640	520	497
59. Washout plugs	714	679	776	623	599	815
60. Train-control equipment	6	4	8	4	13	9
61. Water glasses, fittings and shields	1,118	951	907	716	676	955
62. Wheels	790	697	734	580	603	750
63. Miscellaneous — signal appliances, badge plates, brakes (hand)	608	563	572	423	325	418
Total number of defects	47,453	44,491	43,271	32,733	27,832	36,968
Locomotives reported	49,322	51,283	54,283	56,971	59,110	60,841
Locomotives inspected	97,329	94,151	89,716	87,658	96,924	101,224
Locomotives defective	11,526	11,071	10,713	8,388	7,724	10,277
Percentage of inspected found defective	12	12	12	10	8	10
Locomotives ordered out of service	852	921	754	544	527	688

Result of a fire in a rail car

Specification Cards and Alteration Reports

Under rule 54 of the Rules and Instructions for Inspection and Testing of Steam Locomotives, 164 specification cards and 3,732 alteration reports were filed, checked, and analyzed. These reports are necessary in order to determine whether or not the boilers represented were so constructed or repaired as to render safe and proper service and whether the stresses were within the allowed limits. Corrective measures were taken with respect to numerous discrepancies found.

Under rules 328 and 329 of the Rules and Instructions for Inspection and Testing of Locomotives Other Than Steam, 578 specifications and 96 alteration reports were filed for locomotive units and 538 specifications and 182 alteration reports were filed for boilers mounted on locomotives other than steam. These were checked and analyzed and corrective measures taken with respect to discrepancies found. No formal appeal by any carrier was taken from the decisions of any inspector during the year.

EDITORIALS

Photographers, Attention!

We experimented a bit on the Gleanings page in our September, October and November, 1936, numbers, but if the innovation was noted at all it did not bring any reactions to the editorial sanctum. There must be among our readers a considerable number who use the camera discriminately to bring out artistic and unusual subjects and effects. An apprentice on the Northern Pacific, for instance, made a unique night picture of the head end of a passenger train, which we used in September; a "shot" of the Blue Comet, with technical information as to the exposure, appeared in October, and a rather interesting study of a group during the noon hour at the Readville, Mass. (not Conn.), shops of the New Haven, was used on the Gleanings page in November. How about it, photographers? Have you similar studies that you would like to submit for use in our pages?

Apprentices On Tour

"To see at first hand the operations of a number of the most outstanding railway and private industrial enterprises and thus broaden their general knowledge, a group of thirteen railway (Victorian) apprentices left Melbourne last month on a seven-days educational tour of New South Wales."

Thus reads in part an item in "The V.R. (Victorian Railways) News Letter." Victoria and New South Wales are adjacent states in Australia. It would appear that a reciprocal arrangement exists for the interchange of visits of the railway apprentices of these two states, and that in this instance the Victorian apprentices were guests of the New South Wales Railways Department. The students in the group were selected because of the high standard of their work during their two-years apprenticeship. What a wonderful opportunity for these particular young men and for the railroads involved, as well!

The American railways owe much to the old-fashioned boomer mechanic, who, after he became a journeyman, moved about the country from job to job, gathering experience, until he finally settled down, although some of them never could be content to remain too long in one place. With their widely varied experiences they could be depended upon to do most any kind of a job in an emergency, and do it well.

Today, as one of our readers recently pointed out, conditions are such that the boomer mechanic has practically entirely disappeared and the younger mechanics normally have little opportunity to broaden their experience beyond that of the plant in which they serve their time. Something should be done to fill this gap. Visits to other shops (railway and otherwise), attendance at conventions and expositions, special school and technical training during apprenticeship, thorough instruction in shop practices under well qualified teachers—these are some of the measures that may be adopted to give the broader and more comprehensive training which is necessary.

It is high time, is it not, now that the railroads are getting back on their feet, that special attention be given to these matters; otherwise the railroads, and the other industries as well, will suffer greatly in the days to come because of inadequately trained workers.

Replacing Machine Tools In Kind

The statement, made at various times in the past, is now being repeated by those who should know better; namely, that railroads generally have shops full of obsolete machinery and do not realize, or at least admit, the economies which may be effected by replacing these machines with modern tools. It is said that most machine foremen and tool foremen are men of middle age and past who have grown up in their local shops and know little of the productive capacities of machines other than those used on their own railroad. In proof of this assertion, the instance is cited of three worn-out turret lathes recently replaced by three new machines which were, however, definitely specified of a design outmoded over ten years ago.

The only reason for giving space to this account is to deny it as an unjust reflection on railway shops and railway managements. It is not true that railway shops, particularly those being operated today, are full of obsolete machinery and largely officered by men unfamiliar with the possibilities of modern machine practice. Doubtless individual instances may be cited in support of the statement, but, in this case, the exception does not prove the rule, any more than it did when a survey of modern machine tool manufacturers' plants some years ago disclosed the surprising fact that some of their own shop machinery was 40 years old or more.

Of course, the real reason that railway shop machine conditions are no better than they are is that, roughly, 30 per cent of railway mileage is in receivership and it is often exceedingly difficult for local shop superin-

tendents and foremen to get authorization for new maintenance tools which involve a charge to capital expense. To say that they don't know what they need, however, is, in general, manifestly unjust.

With this background statement, the admission may well be made that, in spite of a considerable purchase of railway machine tools last year, and more in prospect for 1937, there are few, if any, shops not handicapped by the presence of some machines which can be replaced, with a saving of at least 30 per cent on the investment. Few shop foremen and tool supervisors are so well posted that they can not increase their knowledge by visiting other railroad and industrial shops. Few higher railway officers are so keenly aware of the possibilities of modern machine tools that they cannot well afford to re-study the last machinery budget request by the superintendent of motive power and put back some of those tools which were lopped off.

Air-Conditioning Research

The value of well organized research on the part of the railroads as a whole is no more clearly demonstrated than in the remarkable study made last year by the Division of Equipment Research of the Association of American Railroads on air conditioning of passenger cars. The individual railroads and the Pullman Company have for several years been experimenting with and studying this problem, with the result that on October 1 of last year there were 8,031 air-conditioned passenger cars in the United States and Canada. Several different types of apparatus were in use, and these were in various stages of development, since the first installations in railroad service were made only a very few years ago.

Railroad officers have felt keenly the need for accurate data as to the costs and performances of the different types of apparatus; indeed, without such information it is impossible intelligently to select that type of equipment which will function most successfully under the conditions prevalent on a particular railroad.

Recognizing this need and the importance of prompt action, the Association of American Railroads, through its Division of Equipment Research, laid out a comprehensive plan of research and went forward aggressively to achieve its objectives. Not a few experts acquainted with the problem smiled cynically when they heard of these plans and predicted it would be years before worthwhile information could be assembled and digested. They did not know L. W. Wallace, the head of the division, or the calibre of those associated with him. Representatives of the railroads and of the railway supply manufacturers rallied to the task, giving freely of their knowledge and assistance. As the result, a summary report of last season's tests has already been published, and engineering reports will follow shortly.

Certain important facts and principles have already been established, and plans are being made to follow up other troublesome problems which remain to be solved. Changes have already been made in some of the installations in service and improvements are being made in the design and operation of new equipment.

Some idea of the immensity of the progress already made may be gained from the fact that thorough road tests were made of air-conditioned cars on 31 railroads, involving 594 cars, 5,200 hours and 240,000 car-miles. Laboratory tests were made of 15 air-conditioning systems and six drive mechanisms; 14 cars were tested in the hot room. The analysis of costs is based on an experience record in 1935 of 1,608 cars with a total car mileage of 178,259,768. Comments were recorded from 5,453 passengers in cars under road tests, the exact conditions prevailing when each of these statements were made being a matter of record.

These facts may well be kept in mind in studying the results recorded in an article elsewhere in this issue. The point is that such prompt and comprehensive results are available only where co-operative research on a large scale can be conducted under strong central direction and leadership. There are many other pressing problems in the mechanical department awaiting similar treatment.

Hot Boxes

Under the above title, one of the most comprehensive recent discussions of the causes and effects of hot journal boxes was presented by C. B. Smith, engineer of tests, Boston & Maine, at the December meeting of the New England Railroad Club. As Mr. Smith clearly pointed out, hot boxes may be primarily a mechanical-department responsibility, but they are of concern to the operating department, because of possible upset schedules; to the traffic department, because of delayed deliveries of commercial lading; and to the maintenance-of-way department, because they may result in broken journals and derailments, with attendant damage not only to equipment, but to the track structure.

Admittedly, most of the immediate causes of hot boxes are initiated in terminal yards where corrective measures must first be applied. While the actual number of hot boxes in proportion to the number of journals in service is exceedingly small, the aggregate number of hot boxes on each railroad, as well as on railroads as a whole, is a very substantial figure, and hot boxes constitute a large item of expense, due to damaged equipment, interrupted operation and frequent damage claims for delayed delivery.

With the main conclusions in Mr. Smith's paper, there can be no disagreement: namely, that, under the prevailing system of handling cars equipped with conventional journal bearings, hot boxes cannot be entirely avoided; that hot boxes can be minimized only by the

constant vigilance of an adequate force of inspectors and journal-box packers to cover all cars in all trains; that excessive car impacts in switching must be avoided and journal packing reworked where necessary before trains leave terminals; that, since unfavorable conditions do not always cause hot boxes, inspection forces are sometimes encouraged to take a chance and not provide adequate inspection and servicing when time is limited; that, even when properly serviced before leaving a terminal, journals will sometimes become hot, due to hidden defects; that, if hot-box prevention methods are confined to "the best that can be done under present conditions," the problem will remain acute and probably again be passed on to the next generation to solve.

Considerable worthwhile discussion followed the reading of Mr. Smith's paper, one of the speakers most favorably received being Ralph Hammond, road foreman of engines, New York, New Haven & Hartford, who startled his audience by saying that he *believed* in hot boxes, i.e., hot *fire*boxes. Mr. Hammond referred to earlier days of railroading when a freight train coming down a hill "put you in mind of a comet with hot boxes on each side," and when, as a "hogger" with a long train, his practice was to start out of the terminal and get the train going as fast as he could so that all defective boxes would get hot quickly and the cars could be set out all at one time. Mr. Hammond said that while hot boxes have decreased substantially since the early days, they still constitute a serious problem, particularly on long trains operated at high speeds.

The most prevalent source of difficulty seems to be waste grabs which are said to cause from 55 to 80 per cent of hot boxes. This quite strongly suggests the immediate need of the operating department taking steps to avoid, insofar as possible, excessive shocks to trains and cars, not only in road service, but, particularly, also in terminal handling.

There are several seasons why "the best that can be done under present conditions" will pass the problem of hot boxes on to the next generation for solution. In the first place, present conditions include the waste-packed journal box with its bearing which, though highly developed as to uniform load distribution and ease of renewal, is disturbed in its position on the journal with relative ease under conditions of shock and depends upon a none-too-certain source of oil supply. In other words, as long as a touchy device is to be dealt with its successful operation must depend upon eternal vigilance. But the capacity for eternal vigilance is far from being a universal human quality. In the second place, since the touchiness of the journal bearing arises at several points, a campaign of vigilance directed toward one point which seems to cure one epidemic of hot boxes is ineffective in preventing the next since the cause is slightly different.

The remarkable improvement in the reliability of journal operation which has taken place during the past fifteen or twenty years is the result of reducing to a minimum the uncertainties of journal-box conditions by the development of systematic attention. The uncertainties which still remain, and, no doubt, will as long as the present type of journal bearings are in use, are sufficient to insure that the problem will continue indefinitely to be one requiring special attention. The supervisor who can most shrewdly estimate the arrival of the moment when vigilance with respect to any detail of journal-box attention is relaxed nearly to the danger point and who can then inspire a renewal of that waning vigilance throughout his organization is the one who will have the best records of journal performance.

Twenty-five Years of Federal Inspection

The annual report of Chief Inspector J. M. Hall of the Bureau of Locomotive Inspection to the Interstate Commerce Commission for the year ended June 30, 1936, marks the completion of a quarter of a century of Federal locomotive inspection. Prior to February 17, 1911, when the Locomotive Boiler Inspection Act became obligatory upon the carriers, it was common practice to keep locomotives in service when they were known to be in bad condition, thus subordinating the making of needed repairs to the requirements of power demands. In many instances locomotives were continued in service until failure occurred, resulting in the death or injury of the engine crews.

The twenty-fifth annual report of the Bureau of Locomotive Inspection, abstracted in this issue, shows that 10 men were killed and 91 were injured during the fiscal year ended June 30, 1936, as a result of failures of locomotive boilers or boiler appurtenances, whereas in the annual report for the year ended June 30, 1912, it was reported that 91 men were killed and 1,005 were injured. In the first year during which the Locomotive Inspection Act was effective 6,968 locomotives were held out of service for repairs. This number was reduced to the low figure of 527 in 1932.

The wisdom of the policy of Federal locomotive inspection is illustrated by the improved conditions of locomotives during the past twenty-five years and the reduction in the number of fatalities and injuries from locomotive accidents. The expressions "That's good enough," "Hurry up and get her out," and others of similar character have for the most part been abandoned, especially with respect to defects which might result in disasterous accidents.

However, the latest annual report shows that 16 persons were killed and 215 were injured, in locomotive accidents, of which 10 deaths and 91 injuries were directly attributed to boiler or firebox failures. It is the conscientious duty of every railroadman who is responsible for repairing or inspecting locomotives to aid in reducing such accidents. No locomotive should "go" with defects which have the remotest chance of causing failure. Or would that be the millennium?

THE READER'S PAGE

Shopman Disagrees with Mr. Williams

To the Editor:

Was much interested in the comments on Mr. Williams' articles on scratches and their results, appearing in recent issues, and perhaps it is well to permit a metallurgist to wander around the shop with a microscope occasionally. However, after carefully reading several of these articles, one of our foremen recently remarked:

"I have been in charge of the piston job for 23 years and have seen all sorts of fillets made on the piston-rod crosshead ends, and have only seen one break in that part of the rod, while hundreds have developed cracks between the end of the keyway and the largest part of the taper. There is a thread cut on the other end of the rods, about two inches of deliberately made grooves one-eighth of an inch deep and one-eighth of an inch apart, and I have seen but a few break there. So it appears to me that the slight tool scratch complained of is more or less just so much 'hooey.' I have seen most carefully ground crank pins break about one inch in the wheel seat in less than two years after being applied, while others of the same type, size, and service, applied just as the lathe tool left them, were running until they were removed as being down to the limit. Also thousands of crank pins trued up in the roundhouses by means of portable crank pin truing devices, every one showing tool marks, but never yet heard of one breaking unless in a wreck."

These articles are likely to get the mechanical and non-practical officers of the railways worked up to a point where each man who leaves a slight tool mark or scratch on his work will have to be taken out of service—then what?

A Westerner.

(This letter was received just as we were going to press and so Mr. Williams has not had an opportunity of seeing it. Interestingly enough, however, his article in this number is concerned with the type of piston-rod breaks in the taper fit, to which reference is made in the letter.—The Editor.)

Machinist Objects to Carrying Microscope in His Kit

To the Editor:

The series of articles by F. H. Williams, published in recent issues of the *Railway Mechanical Engineer*, dealing with material failures, has been the cause of much discussion and argument in our vicinity. Machine-shop men particularly have not hesitated to express their opinions, and while agreeing with him in some of his failure analyses, they do take exception to some of his statements.

In one article particularly he states that with a tool properly ground with the correct clearances and set correctly, a fillet can be turned perfectly smooth without leaving any scratches or tool marks. I wonder how long ago he tried this? With the kind of steel that axles and crank pins used to be made from, it was no trick, but with our present-day alloys I believe it would tax even Mr. Williams' ingenuity — although he might use the best grade of high-speed tools—to grind or set a tool that would not crater and leave a scratch that a microscope would not uncover.

The railroad on which I am employed is continually going to considerable expense in developing tools that will cut without scratching—no filing allowed, our inspection being very rigid. Recently a piston rod was condemned because of the fillet adjacent to the crosshead fit having faint tool marks, although I have yet to see a rod break at this point. The fracture generally occurs just inside the crosshead. Piston-head fits and fillets are also carefully machined to a mirror finish; then we deliberately cut a sharp-cornered thread for a nut on the end, but they never break there.

Driving axles are received from the steel manufacturer rough-turned; same have been turned with ¼-in. feed, in appearance like a shallow thread. We turn and grind the wheel fit and journal; fillets are polished; the center is left just as received from the manufacturer, but the fracture invariably occurs just inside the wheel fit.

In my experience, the majority of fractures occur in driving axles, crank pins and piston rods at the point where heavy external pressure is applied, and judging from a paper read by a research engineer at a meeting of the American Society of Metals at Cleveland, others have had similar experience. Parts of this paper read as follows:

"No. 1. A press fit reduces the fatigue strength of an axle to less than half the strength of a similar axle not assembled by a press fit.

"No. 2. Surface rolling of the axle at the sections that are subjected to pressure practically restores the full strength."

All this, to say the least, is confusing to the ordinary mechanic. Mr. Williams says that tool marks are the cause of the fracture; the research engineer says it is a result of external pressure. Possibly it is a combination of both.

Rolling would be a fine solution for the machine shop man if we could be allowed to do it. Tool marks and scratches could be rolled in to the extent that a microscope would hardly uncover them, but everyone knows that they are just rolled in and not rolled out.

Assuming that Mr. Williams is right in that tool marks or scratches are the primary cause of fatigue and that the research engineer is also right in that external pressure reduces the fatigue strength, is it not only fair that the steel manufacturer and metallurgist should assume some of the responsibility and develop a steel that will eliminate the necessity for a microscope as part of a machinist's kit? Pressure fits with the present designs we are compelled to use; in my opinion all failures that occur inside the fit are pure and simple material failures.

Machinist

["Machinist" has apparently overlooked the fact that Mr. Williams has placed much emphasis on stress-corrosion and the part it plays in failures. Indeed, he has quite frankly stated in several instances that it was a question as to which cause—stress-corrosion or poor finish—was more largely responsible for a given failure. The metallurgist has done wonders in improving the materials used in car and locomotive construction. Apparently the finer and stronger he makes them, the more

susceptible they are to fractures starting from roughnesses on the surface finish. Can he be expected to meet "Machinist's" specifications in the last paragraph of the letter?—Editor]

Is This A Car Foreman?

To the Editor:

In an endeavor to enlighten our inquiring roundhouse foreman, I will enumerate a few of the qualifications that are insisted upon before one is considered for this highly important position.

First, he must be a gentleman, as defined by Webster. He must also be educated for he is confronted with the task of building, rebuilding and maintaining our luxurious passenger cars, with their intricate air conditioning, water raising, high-speed brakes, heating systems and rocking-chair riding qualities, as well as mail cars manned by much more exacting men than his tallow pots; he must also know how to repair or rebuild any car owner's car in accordance with A. A. R. rules and owner's standards, rendering bills for such repairs in line with those rules; he must be conversant with loading rules covering all classes of lading (roundhouse foremen excepted); he must have full knowledge of the I. C. C. laws covering all kinds of equipment, even engine tenders.

Our good friend the roundhouse foreman should not confuse work in the car department with his in the roundhouse where he hands some white slips to his nut splitters and after the work is completed calls a crew to run the engine up and down by the roundhouse to see if it will stay together and then with the aid of the traveling engineer and six extra oil cans, try to make the next terminal.

The average car foreman has many crafts under his supervision, such as carmen, painters, tinners, pipefitters, acetylene and electric welders, blacksmiths, coppersmiths, upholsters, patternmakers and a few machinists, and he usually finds the latter are very nice fellows and really willing to learn after he has them under his guiding hand a few months. As a suggestion to master mechanics, it may be well to consider machinists with car department experience for future roundhouse foremen, as they really know what it is all about.

A Car Foreman

Metallurgists Too Much For Shop Inspector

To the Editor:

The series of articles on locomotive failures by F. W. Williams, which has been appearing in your paper, is of exceptional value to the inspector whose duties are to investigate and report all failures and their causes, but the problem is how far we can go economically with fine finishes that will stand microscopic inspection.

Perhaps I can illustrate my meaning better by relating my experience at a metallurgists' meeting which I attended a few years ago. Having a couple of hours before train time, three of us barged into the meeting, although I confess it was more to kill time than anything else. It was about zero outside and comfortable and warm inside, which was the execuse one of my companions gave for going to sleep. However, my curiosity was greater than my powers of understanding and I managed to keep awake, although most of the proceedings and speeches were no clearer than mud.

I did start to get interested in the pictures, however. They showed pieces of steel magnified several hundred times, illustrating fine hair checks in different places, the speaker explaining the cause. Eventually one speaker, about six feet six inches tall, every inch of which looked the scholar, showed several pictures of what we assumed were different pieces of steel with the hair checks in different places, and then abruptly finished the discussion and me at the same time by saying, "Gentlemen, these are pictures of the same piece of steel and the reason the check shows in different places is because the pictures are taken with different machines, and the machine has not yet been perfected that will magnify so many times clearly." After this I gave up and joined my companions in sleep.

Inspector

[Mr. Williams has not yet seen this letter and it is only fair to say that most of the photographs which have been used with his articles show magnifications of only a few diameters.—Editor]

In The "Wee Sma'" Hours

To the Editor:

Like a good many others, I enjoy reading the stories of railroad life written by Walt Wyre for your paper, and, no doubt, a good many are true stories of actual happenings. The trials of the day foreman, general foreman and the car foreman are many, I will admit, but the following lines should be food for thought for the pen of our friend Mr. Wyre.

While I agree that stories of the three foremen Mr. Wyre has so far written about are true to life around most any terminal, the man who really has tough problems is the last man usually thought of, and I speak of the night roundhouse foreman at any division point. He is the man who does the finishing up and is always operating with less help than he needs. He is the man at night that deals directly with the operating department and the dispatcher, and regardless of whether an engine is wanted for an extra or to double-head a regular train, or if the snow plow is wanted, the wrecker, or possibly a car brassed, the night foreman must handle these items in addition to getting his regular work done, for the general foreman and the car foreman are home asleep. Possibly one car inspector is around with more cars to look over than he can get to.

To start with, before his promotion to foreman, the average night foreman was considered a good nut splitter by his master mechanic, and thus he was in due time recommended for promotion; and the first thing he learned, when taking over the night job was that he must be the judge not only of the machinist's work, but of the boilermaker's, pipeman's, electrician's and all others', including the stationary fireman's. All the functions to which a man is usually assigned in the daytime become a personal matter for the night foreman, as he won't have a man for every job. It is a well-known fact that every accessory to the roundhouse, such as the coal chute, water-treating plant, turntable, water tanks, etc., always picks out some time after sundown to fail.

So I say to you, Mr. Editor and Mr. Wyre, while you are giving out sympathy for the others, go to any large roundhouse some night and follow the night foreman around from 6:00 p.m. to 7:00 a.m. and I know you will learn some real railroading problems, and see them handled right now.

Night Roundhouse Foreman

Gleanings *from the* Editor's Mail

The mails bring many interesting and pertinent comments to the Editor's desk during the course of a month. Here are a few that have strayed in during recent weeks.

Improve All Services

Another point the railroads might consider is improving all of their services as best they can, rather than concentrating on one or two trains—and letting the balance of their trains suffer by comparison. After all, one "super" train cannot possibly bring in all of the revenue on a railroad, and cannot cover all points, so why not try and spread out the money to make the other trains as attractive as possible?

"Finished" Apprentices

Now that business has started to increase and apparently promises to become heavy, the railroads are seriously handicapped by the lack of experienced men. Despite the statistics on unemployment, a sufficient number of experienced men is not available and "finished" apprentices are hopeless. Because of greed for profit, or in the interest of increased production for low rates of pay under union agreements, apprentices on some railroads are required to serve four years finding out how to do not more than three or four operations. When such apprentices have "finished" their four years they do not have the required experience or ability, they have little or no confidence and are totally unfit to assume the responsibilities required of a mechanic.

Model Railroad Nuts

You, no doubt, are aware of the hobby of model railroading and how it is spreading over the country. This is playing a really important part toward an era of good feeling to the American railroads. It is interesting to note that each of these enthusiasts has a special reason for the particular model he makes or purchases. Where the hobbyist chooses a certain railroad to model, he may be a stockholder, he may like the road's passenger service, or he may like the appearance of the motive power. One leading manufacturer in his line of business was won over because he liked the clean way both passenger and freight locomotives were kept. Naturally he favors this road when he travels and, above all, with his shipments. The model railroader soon learns many fine points of railroads. They can soon pick out the faults in the make-up of a passenger train; their enthusiasm is not very high for the road that insists on operating day coaches behind Pullman cars, especially the observation type of Pullman. They are aware that operating conditions make it more economical, nevertheless the fine touch is lost. Incidentally, there are many thousand travelers among these model "bugs" that do not want to see the open-end observation Pullman pass into history.

How Big Is A Foreman?

One of the greatest things that come to me is in having a foreman who is broad and big enough to carry the responsibility of his department when failures arise, and not try to shift the responsibility on to others who come under his charge. Much has been said regarding the roundhouse foreman. I believe that the most successful roundhouse foreman is the one who will meet the men who operate the locomotives with a smile and is ready and willing to co-operate with them in the little things that they ask. I realize that if the mechanical department, from the superintendent motive power to the roundhouse foreman, has the full co-operation and good will of the men who operate the locomotives, they will surely be successful, as these men can either make them or break them. In order to do this the heaviest responsibility falls upon the roundhouse foreman, who must meet and greet them with a smile and always be ready and willing to listen to their complaints. Even though you may know that these complaints do not amount to a great deal, the men who are trying to express them do feel that they are very important and if you fail to listen to them, they feel very much hurt. Therefore, in order to be a successful roundhouse foreman, you have to listen patiently to many things that are very boring.

Merchants Express of the Delaware, Lackawanna & Western.—Photographed at West Summit, N. J., by Thomas T. Taber

With the Car Foremen and Inspectors

Interior view of the shed showing facilities for sand-blasting car roofs

Sand-Blasting Operations At Burnside Shops

Sand-blasting operations on Illinois Central passenger cars are performed in a special shed adjacent to the passenger car shop at Burnside (Chicago), Ill. This shed, 150 ft. long by 20 ft. wide by 23 ft. high, comprises a wooden frame with sides extending nearly to the sheet metal roof, having one end leading into the car shop and the other end open. The shed covers one track, and is equipped with double-side scaffolds 36 in. and 10 ft. high, respectively, on which operators may stand while sand-blasting the sides and the roof.

A suitable supply of sand is carried in drier and storage cars just outside of the shed in which the sand is properly dried and screened. The storage car is tilted to give gravity feed to one end from which the sand is fed under manual control into a 22½-in. by 54-in. tank set vertically in the ground. After the filler plug is closed and air pressure applied to this tank, the sand is raised through a 1¼-in. pipe into a 40-in. by 60-in. tank also set on end and designed to hold the sand in readiness for blasting operations. There are three of these 40-in. by 60-in. tank units; also one large reserve tank for sand and another large reserve tank in the shop air line to avoid fluctuations in air pressure when multiple sanding operations are being carried on.

Each of the 40-in. by 60-in. tanks has an opening on top for the escape of air while being filled with sand. The sand drops from the bottom through a pipe connection to a sand-mixing valve in which sand and air are mixed as they pass at 70-lb. pressure into the air-delivery hose. The amount of sand delivered to the air stream is governed by the air pressure and the size of the hole through which sand is fed to the mixing valve. Good results are secured by making this a 9/16-in. hole drilled in a removable plate which may be substituted for a plate with a larger or smaller hole if required by special conditions. Two other valves govern the air pressure on top of the sand and in the hose.

A 1½-in. standard sand-blast hose is used, the service life secured being about three months. Standard 1¼-in. air hose couplings are employed, also a 1¼-in. by ¾-in. or ½-in. reducer coupling, dependent upon the nozzle-size required for the best results. Straight nozzles, 20 in. to 50 in. long, are used, the ½-in. size being more economical for sand-blasting small parts. The best cutting action is secured when directing the sand against the part being cleaned at an angle of about 45 deg. The hardest material to cut is the enamel on vitrified hoppers.

Particular precautions are taken to assure the safety and good health of the sand-blast operators. The men receive monthly physical examinations and are employed on this work only for four-month periods. The latest type of protective hood is provided for the operators, clean filtered air being supplied to the hoods at a pressure of about 5 lb., adjustable by means of a needle valve. The hose is attached to the man's belt in such a way as to take the weight off his head.

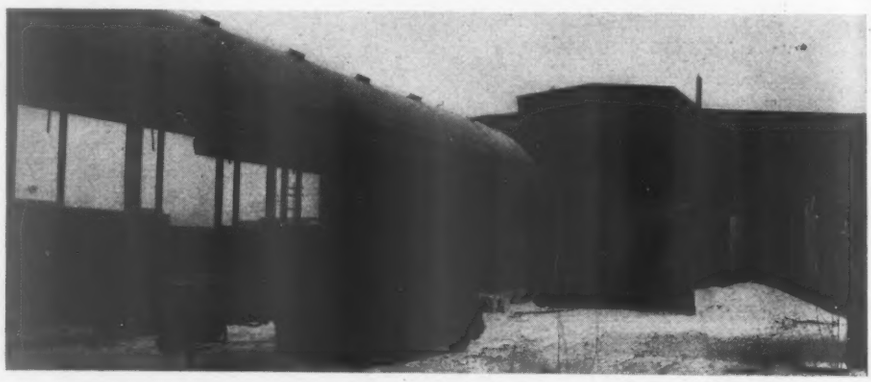
Preparatory Work Necessary

The kind of preparation necessary in getting cars ready for sand-blasting depends upon the type of car and nature of work being done on it. All cars are stripped and passed into the sand-blast shed on their own trucks. The easiest job is an all-steel car which may be sanded inside and out without special protection. If the car interior does not require sanding, a spare set of convas-equipped sash is applied in place of the regular glazed sash to protect the interior. Composite interiors which require sanding of the metal ceiling have the wood deck molding shielded with canvas. Exterior sanding is performed by one man working simultaneously on each side of the car or on each side of the roof. For overhead sanding, the weight of the relatively long and heavy hose is carried by a pulley on a guy wire, there being one wire on each side of the shed. When working on both sides of the car or roof at the same time, the sanding operations are staggered to avoid one man interfering with the other. Underframe parts and trucks are sand-blasted by the ground men. After the car is completely sanded, it is blown out, pulled, and the accumulated sand shoveled up and returned to the storage car for re-use until the cutting edge is reduced too much for efficient sanding.

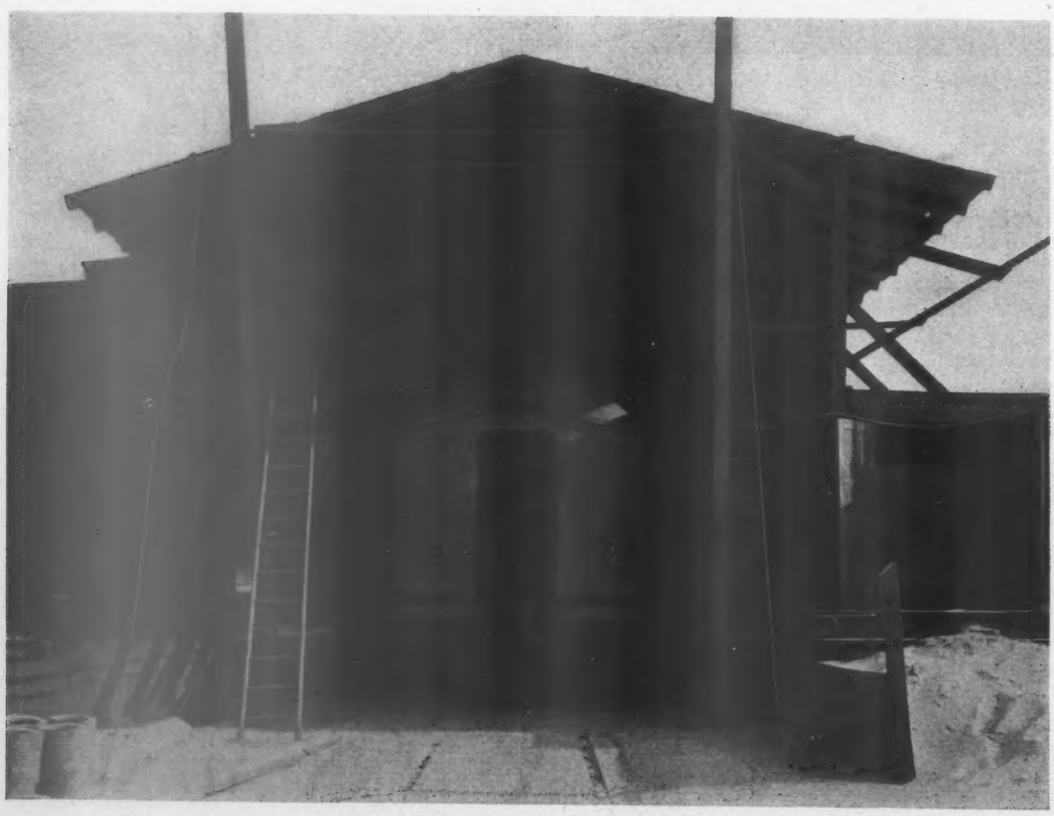
Cost of Sand-Blasting

In many instances, some of the elements of cost in sand-blasting operations are overlooked and the result is that railroad men quote figures which are too low and which prove misleading regarding the real cost of this important work. As would be expected, the actual cost of sand-blasting depends primarily upon the type of car,

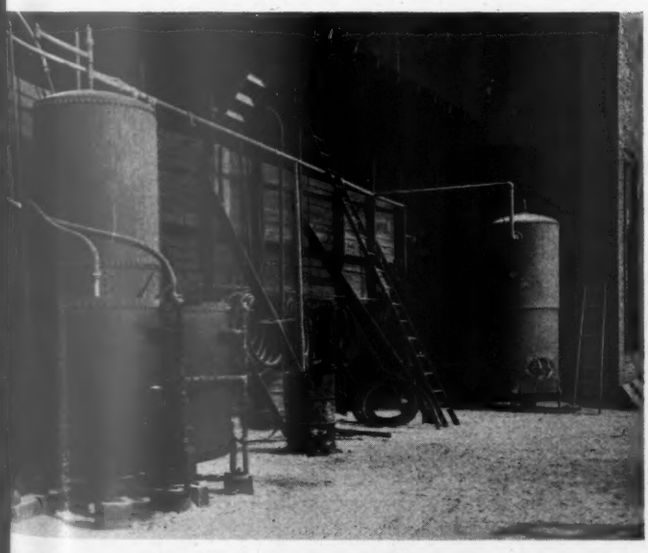
Right—Car due for extensive conversion job ready to enter sand-blast shed



Below—Sand-blast shed at Burnside shops of the Illinois Central



Sand-blast unit used in cleaning small car parts outside the shed



Sand-blast tanks and equipment outside the shed

its condition and the amount of reconditioning work being done on it. The car size, amount of interior metal finish, window area and condition of the underframe and trucks as regards corrosion all are important factors.

Referring to the tables, it will be observed that the sand-blasting of a typical Illinois Central baggage car cost $121.45, including all elements of cost, and sand-blasting a typical coach cost $87.36. The largest single element of cost in the baggage car is for sand-blasting the inside of the car, including the ceiling, and the next largest item is for sand-blasting the heater coils, guards, ventilator collars, handrails, etc. In the coach, the largest single item is for sand-blasting the roof, and the next largest is for cleaning up after sand-blasting. The cost of air, steam and electricity is included in the 20 per cent allowance for shop expense.

Cost of Sand-Blasting Baggage Car

Parts Sand Blasted	Hours	Labor	Mat'l.	Total
Trucks, springs and equalizers	18¾	$8.80	..	$8.80
Inside of car, including ceiling	75¾	32.29	..	32.29
Outside of car and roof	55	23.87	..	23.87
Heater coils, guards, locker, ventilator collars, center castings and hand-rails	70	30.27	..	30.27
New panels	5¾	2.53	..	2,53
2 battery boxes and equipment box	5	2.58	..	2.58
Generator castings	2	.87	..	.87
Total sand blast	233¼	$101.21	..	$101.21
Plus 20 per cent shop expense				20.24
Grand total				$121.45

Cost of Sand-Blasting Coach

Parts Sand Blasted	Hours	Labor	Mat'l.	Total
Generator castings	2	$.92	..	$.92
Trucks and springs	14½	6.93	..	6.93
Roof	38¾	18.46	..	18.46
Outside of car	27½	12.40	..	12.40
Inside of car	24	11.29	..	11.29
Clean up after sand blast	41	17.40	..	17.40
Battery boxes	3½	1.60	..	1.60
New patches, window stops and water collar stands	8¼	3.80	..	3.80
Total sand blast	159½	$72.80	..	$72.80
Plus 20 per cent shop expense				14.56
Grand total				$87.36

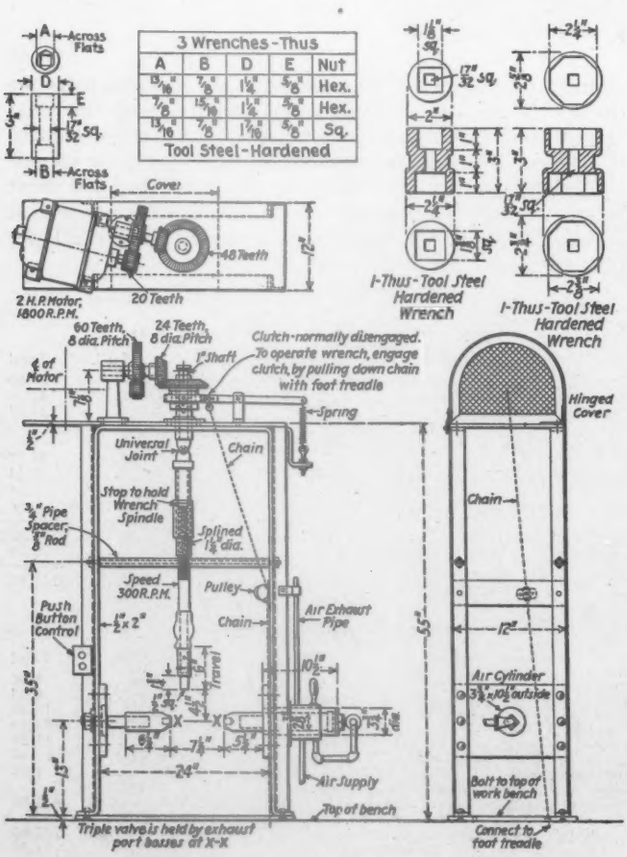
Machine for Dismantling Triple Valves

The triple valve dismantling machine shown in the figures has sufficient power for the removal of nuts, caps, and retarding devices (on the K type triple) and can be used to dismantle a triple valve completely in two minutes. Power is supplied by a 2-hp., 1,800-r.p.m. motor geared to a shaft equipped with a friction spring release clutch which is in turn connected through a universal joint to a telescopic spindle.

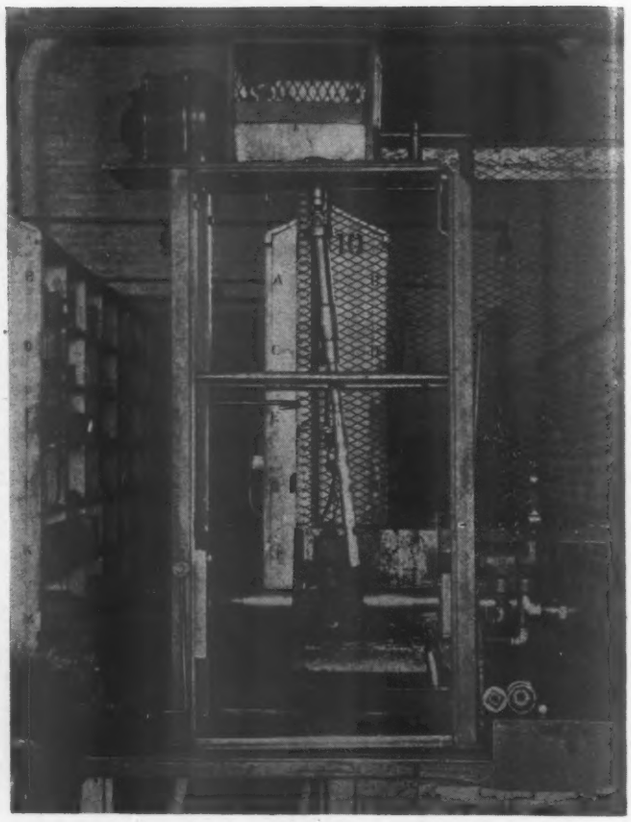
The triple valves are held by two cylinders mounted on the frame. The ends of the cylinders, shown as *XX* in the drawing, are drilled and counterbored to fit over the triple-valve exhaust-port bosses, and drilled to a depth sufficient to prevent contacting the pipe plugs which are screwed into the exhaust-port threads. The left-hand cylinder is stationery, while the right-hand cylinder is fitted with a plunger operated by a straight-air brake valve.

When dismantling a triple valve, the valve is placed between the plungers at *XX* with the check-case plug resting on a wooden block set in the center of the table, and with the cylinder cap pointing towards the operator. The operating valve is then placed in an open position which causes the plunger to move out of the right-hand cylinder, thus clamping the triple valve between the plunger and the left-hand cylinder. The valve can be turned so that either the cylinder cap or the check-case bolts are in position. The proper socket wrench, dimensions of which are shown in the drawing, is placed on the spindle and, due to the fact that the shaft is telescopic, the wrench can be brought down to contact with the part to be removed.

A foot pedal is connected by means of a chain and a spring balanced lever arm to a clutch at the top of the frame. When the foot pedal is lowered the clutch engages, causing the wrench to revolve. If it is desired to lock the triple valve in position, a hook located on the front face of the left frame is placed in the check-case opening.



Details of the triple valve dismantling machine



The dismantling machine with a triple valve set between the clamping cylinders

Questions and Answers On the AB Brake

118.—*Q.—What ports are open in the other step of service position?* A.—The same as in the first except that communication is now closed between brake pipe and brake cylinder by the limiting valve. This occurs when a predetermined amount of air has been accumulated in the brake cylinder. Any further pressure in the brake cylinder is obtained from the auxiliary reservoir.

119—*Q.—What ports open in service lap position?* A.—The same as in above, with the following exceptions: Flow of auxiliary reservoir pressure to brake cylinder is cut off by the service graduating valve. The opening from quick action chamber to atmosphere is cut off by the emergency graduating valve and communication is re-established between brake pipe and quick action chamber via charging choke.

120—*Q.—What ports open in emergency, first stage?* A.—Quick action chamber to vent valve piston chamber. Quick action chamber to atmosphere via choke No. 109. Brake pipe to atmosphere past the unseated vent valve. Brake pipe to the accelerated-release check valve chamber. Auxiliary reservoir and emergency reservoir to brake cylinder past the inshot valve, and the two reservoirs are connected to their respective checks in the du-

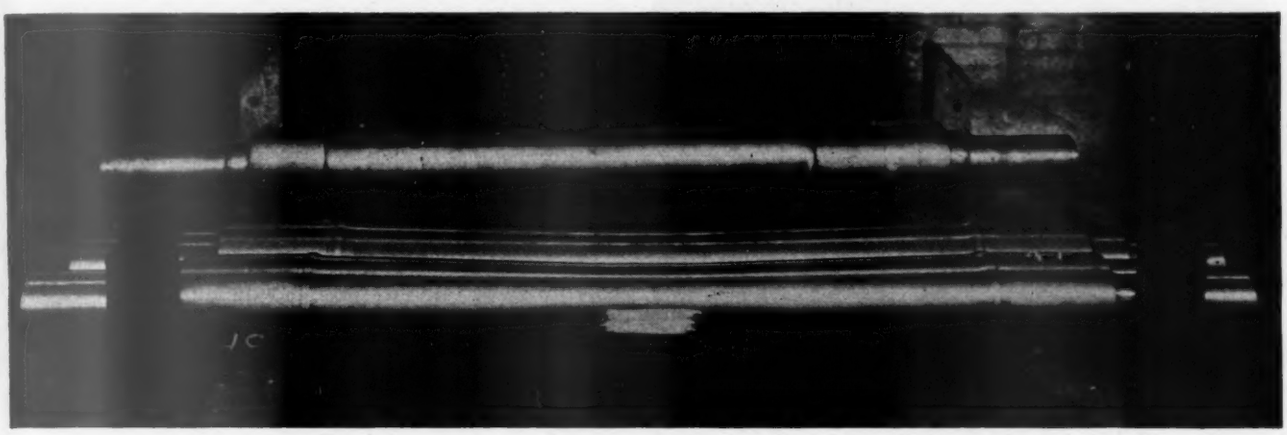
plex release valve. Emergency reservoir to accelerated release piston chamber, and to spill over checks and strut diaphragm. Auxiliary reservoir to the release-insuring valve.

Precision Wheel and Axle Work

The advent of modern light-weight high-speed trains has served to emphasize the need not only for reliability in wheel service, but for accurately-balanced wheels, in the interests of smooth riding and reduced wheel stresses.

The wheels and roller bearings are dismounted in the wheel shop and all parts subjected to accurate calipering for wear and inspection for possible defects. The axles are thoroughly cleaned, submerged in hot oil at 250 to 270 deg. F. for five minutes, after which they are again cleaned and whitewashed with a mixture of whiting and alcohol. After being allowed to dry, they are hammer-tested with a soft hammer so that any oil in the smallest hairline crack will ooze out and be readily visible against the white coating. All of this inspection work is done under the supervision of a metallurgist from the test laboratory, and if any defects are developed, such as small cracks, arc marks, dents, etc., the axles are rejected.

The axles for high-speed trains are made of carbon steel, heat-treated and double normalized. New axles,



Group of finished Zephyr car axles ready for inspection before wheel mounting

The greatest of care is exercised in inspecting, machining and mounting all parts of the wheel and axle assemblies, including the roller bearings, and the latest practice is to machine the rolled steel wheel hubs and rims after being bored and to grind the treads.

The illustrations show how some of this work is performed at the Aurora, Ill., shops of the Chicago, Burlington & Quincy for car wheels which are to be used under the Zephyr trains operated by this road. Both new and replacement wheels, needed for the protection of this service, are shipped to Aurora shops from terminals such as Chicago, St. Paul, Minn., and Denver, Colo., where Zephyr trains are maintained.

purchased rough turned about ¼ in. above the finish size, are re-machined to a smooth finish all over in a 24-in. engine lathe particular attention being paid to the provision of large well-polished fillets. The ends on which the roller-bearing cones are pressed are ground and the wheel fits are smooth machine-finished. Between the wheels, the axle is smooth machine-finished and no tool marks are allowed.

New wrought steel wheels are supplied rough turned and bored, with 1 in 20 taper treads on power wheels and semi-cylindrical treads on trailer wheels. The wheels are machined on the vertical turret lathe being bored accurately and smoothly with the proper shrinkage al-

Zephyr wheel-and-axle assembly with Timken roller bearing boxes in place and axle covered by heavy canvas for protection during shipment

Machining Zephyr car axle on a Boye & Emmes 24-in. engine lathe at Aurora shops

lowance for a press fit on the axle. The finish cut is made with a double-end floating tool, the tolerances being .0005 in. in diameter and .001 in. taper. The wheel is faced lightly on the hubs and rims to overcome any possible irregularity in exterior surface and to bring it in accurate balance. The inner wheel hub is undercut slightly to reduce axle stress just inside the wheel fit and prevent the starting of a fatigue crack at this point. After mounting the wheels in accordance with standard practice, the treads are ground perfectly round to within a tolerance of .005 in. Reconditioned wheels also are ground on the treads after being turned.

Assembly of the roller-bearing cones, journal boxes and parts is made in accordance with rigid instructions, based on Timken experience in assembling a roller-bearing unit, which will give maximum satisfaction and reliability in service. The greatest care is exercised in handling axles about the shop, felt pads being invariably inserted between the axles and any lifting chains which may be used. Reference to one of the illustrations shows the heavy oil-impregnated canvas cover which is applied over the center of the axle and securely laced in place to protect the axle against accidental marring or corrosion while wheel and axle assemblies are being shipped from place to place.

Stack-Cutting Plate Material*

To meet the demands of modern mass transportation it has been necessary for the railroads to set up heavy repair programs on production-line schedules with movements or deliveries of cars within time periods of from 18 to 24 min. The maintenance of the production-line schedules is dependent upon the ability of the fabrication department to furnish new material or parts for replacement of those which are unfit for further service, on time.

The fabrication department is called upon to manufacture thousands of identical pieces during the course of a regular heavy repair program and the development of stack cutting of plate material by the oxy-acetylene flame-cutting process has proved to be the greatest step forward in fabrication methods that has been made in years.

As all of us are undoubtedly familiar with the use of oxy-acetylene process for the cutting of iron, and its principal alloy, steel, there is no need for any discourse on the reaction of pure oxygen with iron and, therefore, only a description of the practical use of the oxy-acetylene cutting process as applied in our shop to the manufacture of freight-car parts which are fabricated from steel sheets or plates is presented, with the hope that this information may prove of value to those having similar problems.

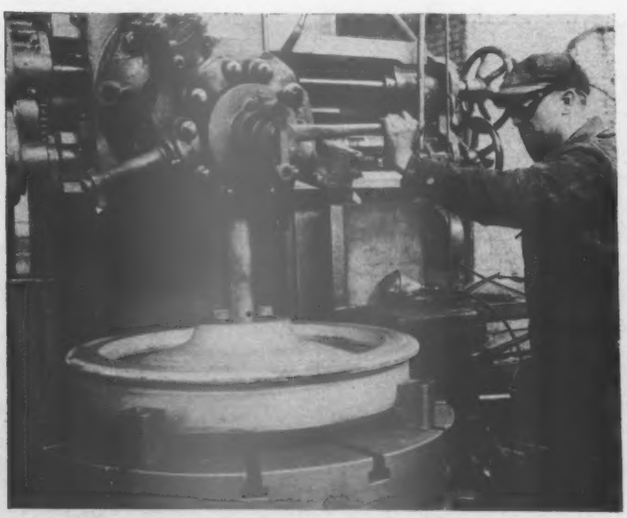
Stack cutting, as the term infers, means the cutting by the oxy-acetylene process of sheets or plates piled or stacked upon one another to a definitely determined height. It is, of course, evident that the cutting torch must be moved over the stack mechanically to obtain smoothly and accurately cut edges, and it is therefore a machine operation.

The machine installed at our shop has a cutting range of 81 in. transversely and 24 ft. longitudinally. This large capacity was provided to meet the production demands of the fabricating shop and permits the economical cutting of four different parts of large dimensions in progression.

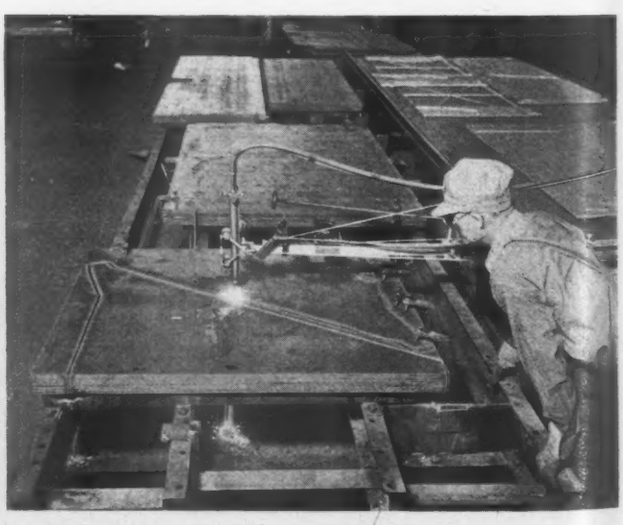
The Template Table and Cutting Jigs

The cutting machine is the type which is automatically guided by means of full sized templates, the guiding mem-

* Paper read at the 37th Annual Convention, International Acetylene Association, held November 18, 19 and 20, at St. Louis, Mo. Mr. Orr is superintendent of car shops, Cleveland, Cincinnati, Chicago & St. Louis, Beech Grove, Ind.



Finish boring a Zephyr car wheel with double-end floating tool in a Bullard vertical turret lathe



The gas-cutting head in operation—Supplementary hand clamps are used where necessary

ber being an aluminum rail suitably fixed to a base. As all of the operations being performed by the cutting machine will be repeated at intervals, permanent templates have been constructed. Due to the large size of the parts cut and the corresponding size of the templates, considerable thought and study was devoted to the development of a template base which would meet the requirements of both strength and lightness. The material selected is ⅜-in. plywood properly reinforced by ⅜-in. by 1½-in. strips attached to the under side with wood screws. The larger templates are made in skeleton form to reduce the quantity of material used and are so designed as to provide a secure base along the line of cut. When in use, the templates are bolted to the top of the cutting-machine table and only the original adjustment is required as the templates are positioned with relation to permanently located jigs and stops. A change from one operation to another consumes but a very short time, as the templates can be exchanged without further adjustment of position.

The stacks of sheets or plates are supported by jigs mounted upon channel-section beams extending the full length of the machine, which are supported in turn upon the work supports furnished with the cutting machine. The supporting jigs are constructed of ⅜-in. by 3-in. steel bars in skeleton form, the outline being slightly smaller than the contour of the part to be cut. The outline of the jig is within the limits of the finish contour to provide clearance for the cutting stream and the slag of the oxy-acetylene cutting reaction. The material is placed upon these jigs by a labor gang and removable stop keys are provided definitely to locate each stack of material without any adjustment after it has been piled.

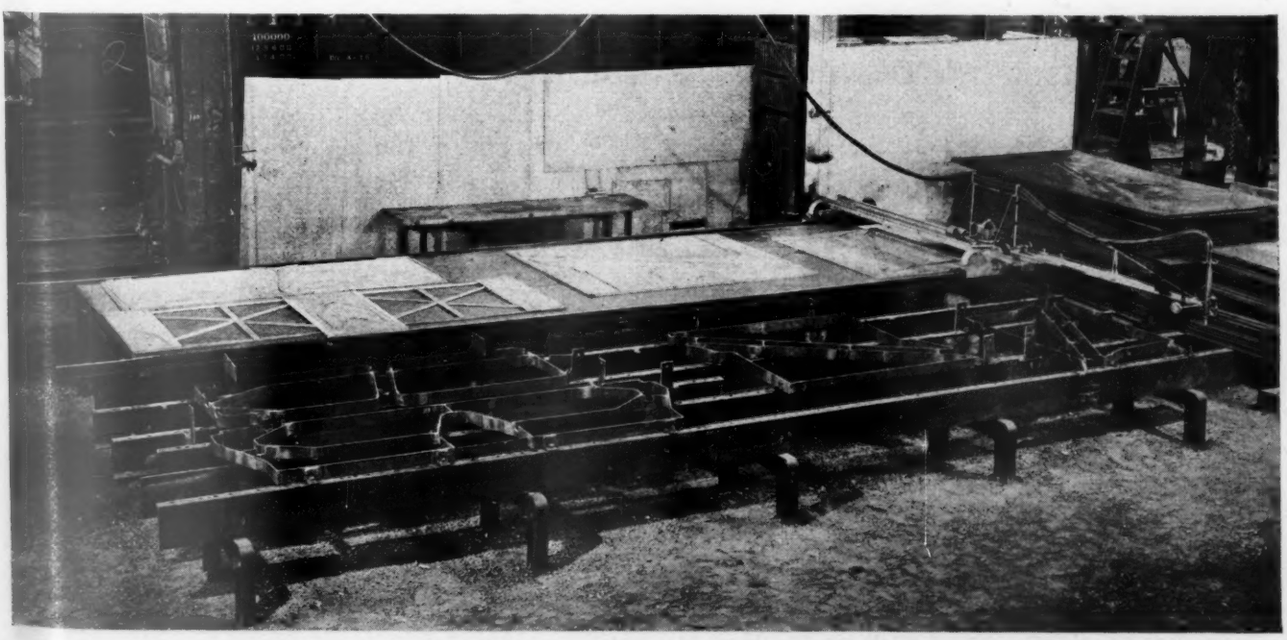
The stop keys are held in place when in use by slots permanently welded to the channel beams. One edge of the slot or keyway is vertical and the other is tapered. With this design, it is not possible for the stop to move out of position and accurate placing of the material at each loading is insured. Provisions have been made to work various sizes of plate stock from the same keyways or slots by making offset keys either extending beyond or receding from the vertical edge of the keyways. All of the keys or stops are identified by markings indicating the specific operation they are to be used on and the location of the stop slot in which they are to be placed. Thus a change of stop arrangement can be made rapidly and no delay in the loading operation occurs.

As previously stated, loading of the plate material is performed by a labor gang consisting of two men who also have the duties of assisting with the unloading of the cut material by overhead crane and separating the cut sheet sections for subsequent handling by punch operators. The labor gang loads the sheets on the jigs from stock piles conveniently located adjacent to them. The sheets are loaded one at a time in order that a visual inspection of the surface condition may be made, the surface can be cleaned and any matter which might prevent bringing the sheets in close contact for the cutting operation can be removed. Sheets or plates having kinked or buckled edges are straightened before being placed in the stacks to avoid separation of the material while cutting. This preliminary preparation has a very definite value, as by careful loading a good, clean cut is obtained without any interruption.

Loading and Clamping the Plates

The sheets are loaded 12 high in our case where material ¼ in. thick is used, the stack thickness being nominally 3 in. Stacking to this thickness has been developed through a careful study during which all factors of time and the cost were considered. With a number of different sheet sizes and with variations in the lengths of cuts to form the various parts, it was found to be most economical to load 12 sheets in order that the loading gang could load progressively ahead of the cutting operation and no delay to the cutting operation would occur.

The material is loaded progressively, that is, the jigs are filled starting at one end of the machine and proceeding to the pig at the opposite end. The loading of the jigs continues, as does the unloading of them, while the cutting operation is being performed and the entire operation becomes a complete cycle of loading, cutting and unloading. As soon as it is possible to do so, the cut stacks are separated by the same labor gang who make certain that there is no adhesion between the cut sections so that they can be easily handled through the subsequent fabricating operations. It might appear



Gas-cutting machine of large capacity with templates in place and material-positioning jigs ready for loading

to some that due to the heat of the cutting reaction, the edges of the sheets might become fused together. This action, it may be assured, does not occur under any condition. With certain improvements which have been made in cutting-nozzle performance, the operation of separating the cut sheets has nearly resolved itself into one of inspection in which it is only necessary to slide the sheets apart to make certain there is no adherence.

To insure close contact between the sheets, pneumatic clamping devices have been erected. These are so designed that pressure can be applied quickly along the line of cut. The pressure is applied through levers moved by fulcrum bars extending along the sides of the work supports. The prime movers are 10-in. by 12-in. brake cylinders operated from the shop-compressed air supply with a pressure of 90 lb. per sq. in. The pressure levers or bars are so designed that they can be easily removed to permit unloading and loading. The labor of removing and applying them is performed by the labor gang.

The operator inspects the stack in order to assure himself that the preparatory work has been properly performed and a good cut will result, after which he applies the clamping pressure. With the pneumatically operated clamps, the pressure is applied quickly and uniformly and the stacks are securely held against the jig forms.

The Cutting Operation

The cutting operation is started immediately after the clamping operation is completed, a single operator handling the machine. The driving mechanism is controlled from the blowpipe end of the machine through a lifting and revolving device. The feed or cutting speed is regulated at the motor through a governor setting and as a constant speed is used for the 3-in. stacks, very little regulation of motor speed is required. With the lifting device, the machine can be moved from template to template from the front or blowpipe end of the machine and there is no need for the operator to move from the normal line of operation to perform this work.

The cut is started at the edge of the stack against the gaging stops and, if continuous, is not interrupted until the cut is completed. In cases where the lines of cut intersect and stop at the point of intersection, gates or switches are provided in the templates and when the cut reaches the point of intersection, it is stopped until the gate can be moved into the proper position. The cut is then resumed by starting through the kerf at the point of intersection of the two lines of cut.

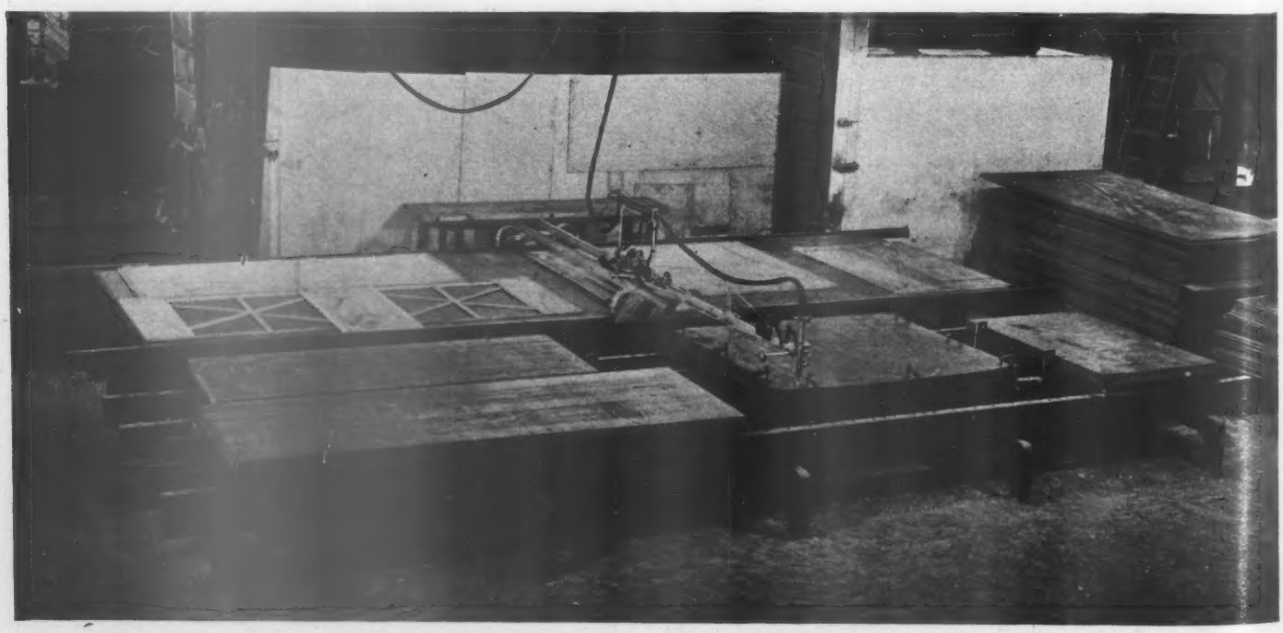
The speed of the machine is so regulated as to give a good smooth cut with the greatest economy. In determining the proper size of stack to be used to obtain the best and most economical results, a great deal of study was devoted to the size of nozzle, oxygen operating pressure and speed of cut, as well as to the loading factor. It was found that greatest economy could be obtained with a 12-plate stack of ¼-in. material which permitted using a medium-size cutting nozzle at nearly top speed for this thickness of material.

Operating Results

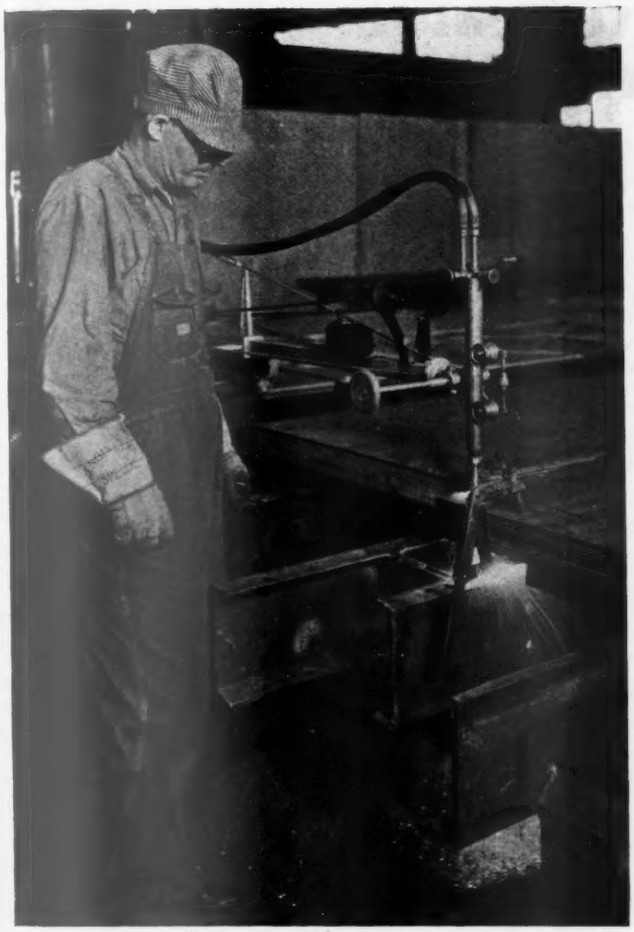
The results obtained through the use of the oxy-acetylene cutting process in stack cutting of freight car parts have fully met the expectations. Cost records which have been carefully made since the cutting machine has entered into full production show an average saving over a 14-day period of 16 per cent in the direct cost as against doing this work by shearing methods. This comparison does not consider any factors of overhead such as maintenance of shearing machines and blades nor power costs, nor does it include the saving effected by reducing the many handlings of this class of material which are required with shearing.

It is evident too that the saving in direct cost will increase as better schedules of supplying the sheet material to the machine and of unloading the finished work are worked out.

There is another factor of importance which must not be overlooked in considering the saving which can be effected through the use of the oxy-acetylene process in the stack cutting of steel sheet or plate material and that is the large saving or earning which is obtained from the recovery of new usable material. With shearing and coping methods, it is not possible to recover much of the waste material removed from the sheets in pieces large enough for use in the manufacture of the smaller parts required in car construction. This is particularly true where recesses are sheared by means of a coping shear, as the material is removed in small bits which go into the scrap bins. The material removed from recesses by



While cutting one stack of material, other stacks are being positioned and clamped ready for the cutting operation



The gas-cutting head completing a long cut in a stack of material

the oxy-acetylene cutting process is in one piece and of such size as can be used for the manufacture of other parts. It is not possible to set up an average figure to represent this saving, due to the variation in the work, but it is recorded that usable material to the value of nearly $200 has been recovered during a six-work-day period at our shop.

In conclusion, it may be well to make a comparison of the quality or workmanship obtained by shearing and by cutting with the oxy-acetylene cutting machine process. When the sheets are cut in stacks by the cutting machine, every piece is identical in contour and this contour can be duplicated over and over. This condition is, of course, not possible when the contour is sheared due to the manner in which the layout is made and the chance that slippage will occur under the shearing action.

With the sheets cut by the oxy-acetylene process, it is only necessary to adjust the gaging stops on the pressing dies once, while it is necessary to make frequent adjustments to take care of the variations caused by shearing.

The edges of the oxy-acetylene-cut sheets are square and full, with no burrs or slivers such as are present on sheets pre-fabricated by shearing methods.

There is a total absence of tearing when the oxy-acetylene stack-cut sheets are formed, due to the fact that the cutting operation does not leave any sharp corners which have high stress concentrations and yield under the additional bending stress of the pressing dies. The radii left at such locations in the sheet contour tend to strengthen this section and provide additional material for the drawing action of the die.

In view of the facts which have been developed through our experience and which have been presented as briefly as possible, it is apparent that the stack cutting of sheet or plate material by the oxy-acetylene process has been a valuable development of the industry.

Non-Porous Protective Coating

A line of protective and decorative coatings adapted to application to metal, wood and concrete surface, including passenger cars, locomotives, bridges, buildings, etc., is being offered to the railways by Technical Coatings, Inc., New York City. These coatings, which were developed after several years of laboratory research and extensive service tests, and which have already been applied to many structures, are said to afford a tough, elastic, non-porous surface which will combat corrosion, deterioration and wear over long periods of time. Special features of the coatings, specific types of which are said to be particularly adapted for protecting surfaces subject to corroding gases and brine drip, are in the vehicle employed, which is a specially processed combination of vegetable gums and heat-treated oils, and in the pigments, all of which are metallic in character.

The line of technical coatings includes both primers and decorative top coatings. The primers offered for various conditions of exposure include a zinc metallic coating, an aluminum-zinc coating, and a balanced red lead coating, all of which employ the non-porous vehicle as a base. The top coatings, all of which employ only metallic pigments, are furnished in a wide range of colors, including gray, white, black, buff and green. On order, special colors can be furnished as specified.

All of the coatings are said to have an unusually long life under normal atmospheric conditions, while certain of them are specially recommended for services subject to brine, acids and corroding gases. It is said that tests and actual experience prove that the coatings, in addition to being impervious, adhere tenaciously, and will not crack or peel with expansion and contraction caused by wide temperature changes.

* * *

Fountain-head brush used for washing the exterior of cars—The secret of the effectiveness of this method is the use of a small hose (⅜-in. service station hose) to carry the water to the brush head

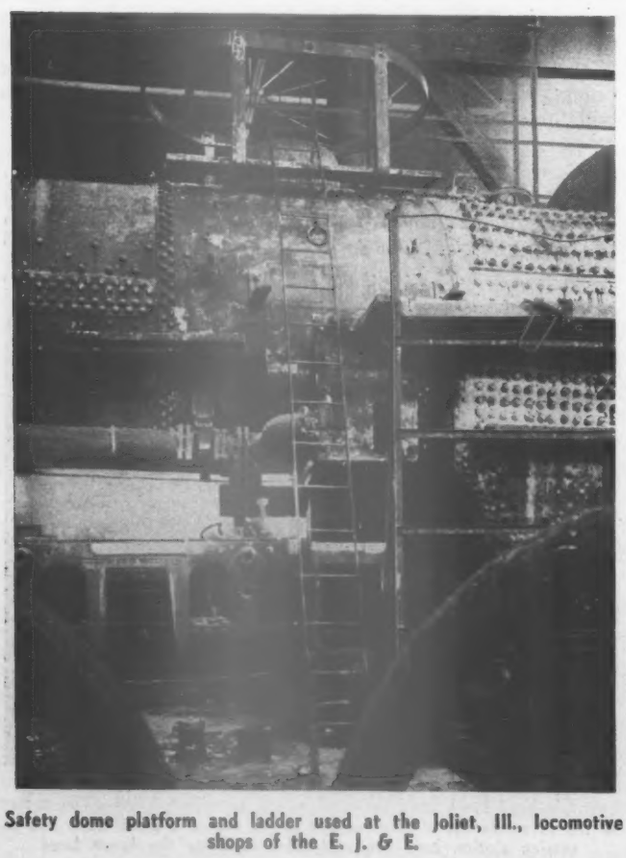
IN THE BACK SHOP AND ENGINEHOUSE

Safety Platform for Dome Work

The illustration shows a substantially-constructed safety dome platform which may be readily applied over the dome of a locomotive undergoing repairs and provide ample protection for workmen who are engaged in making throttle repairs or doing any other work around the steam dome. The upper rail of this protective platform is approximately 7 ft. in diameter and made of 1-in. by 4-in. steel bar stock, being supported on four uprights made of the same material and continuous with the two bottom supports which rest on and are fitted to the curve of the boiler. A plank placed across these bottom supports on either side of the dome affords a secure footing.

The safety dome platform is sufficiently heavy so that there is little tendency for it to slide or slip even when the weight of one or two workmen is concentrated on one side. To serve as an added precaution, however, the actual bearing of the bottom supports against the boiler consists of four 2-in. by 4-in. by 6-in. wood blocks bolted to the supports.

The steel ladder, shown in the illustration, also is more satisfactory than most wooden ladders, being relatively lighter and stronger. This ladder is made of ⅜-in. by 2-in. steel side bars in which ¾-in. round bar steps are inserted and welded, with wood foot pieces bolted to the side bars at the bottom to serve as a bearing against the shop floor and prevent the possibility of slipping.

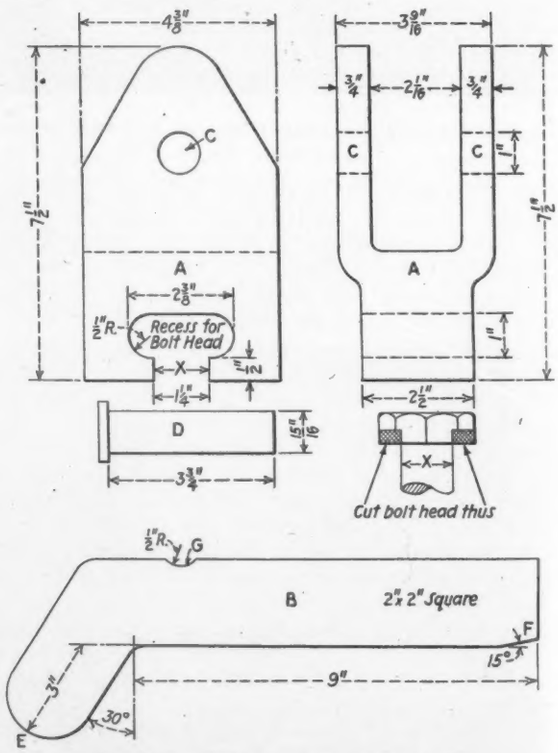


Safety dome platform and ladder used at the Joliet, Ill., locomotive shops of the E. J. & E.

One side of the adjustable safety scaffold, used in connection with boiler work, is also shown in the illustration. This scaffold is 7 ft. long by 44 in. wide on the base and 9½ ft. high to the wood platform. It is made of 2½ in. vertical side angles with horizontal cross angles 1½ in. by 2 in., spaced 24 in. apart. The light guard rail, made of a ¾-in. steel rod, is 22 in. above the 2-in. by 30-in. wood platform which is supported on two steel brackets adjustable for height by means of bolts applied through the vertical side angles.

This adjustable safety scaffold, like the safety dome platform, may be readily moved about the shop by the shop crane and, once suitably placed, contributes both to safety and increased production on the relatively hazardous work on large locomotive boilers. Both devices are successfully used at the Joliet, Ill., locomotive shops of the Elgin, Joliet & Eastern.

Puller for Removing Frame Bolts



Tool for removing locomotive frame bolts

The removal of locomotive frame bolts can be facilitated by the device shown in the drawing. This bolt puller, cut out with an Oxweld automatic shape-cutting machine, places a strain on the bolt head which invariably results in the withdrawal of the bolt. Occasionally it is necessary to sledge the bolt on the opposite end, especially when it seems probable that further application of

pressure on the bolt head may result in pulling the head off the bolt.

The puller consists of a yoke *A* slotted at the bottom to fit over the head of the bolt, and a fulcrum lever *B* for applying the pressure. After the yoke *A* is placed over the head of the bolt, which has been cut away by an acetylene torch as shown in the drawing, the lever *B* is set between the yoke arms and the pin *D* is inserted in the holes *CC*. The ends *E* and *F* of the lever rest on the frame, with the pin *D* in the holes *CC*. The recess *G* keeps the lever in that position. A wedge is then driven under the end *F* of the lever, which is bevelled for receiving the wedge. As the wedge is drawn under the lever, the upward force on the yoke removes the bolt.

Pipe Bushings Made from Extra-Heavy Pipe

It is interesting to know that pipe bushings can be made from extra-heavy and double extra-heavy pipe. The table shows the sizes of pipe, as well as the drill or reamer sizes, to use in making the various bushings. For example, to make a ¼ in. to ⅛ in. bushing, obtain a piece of ¼-in. extra-heavy pipe sufficiently long for cutting the outside thread. Then, cut the end off to the desired length, drill or ream it with a $^{21}/_{64}$ in. drill or reamer, and tap it with a ⅛-in. pipe tap. In making other bushings the table shows that in the case of the ⅜ in. to ¼ in. bushing the internal diameter of ⅜ in. extra-heavy pipe is such that no drilling or reaming is necessary and that in making ½-in. to ⅜-in. bushings either extra-heavy or double extra-heavy pipe can be used.

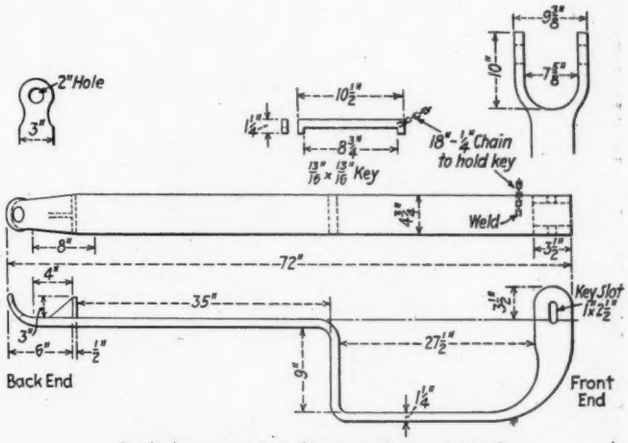
Table of Drill Sizes for Making Bushings from Extra-Heavy Pipe

Bushing size, in.	Pipe size to be used, in.	Drill or reamer size, in.
¼ to ⅛	¼, extra-heavy	$^{21}/_{64}$
⅜ to ¼	⅜, extra-heavy	none
½ to ⅛	½, double extra-heavy	$^{31}/_{64}$
½ to ¼	½, double extra-heavy	$^{27}/_{64}$
½ to ⅜	½, double-extra-heavy	$^{9}/_{16}$
½ to ⅜	½, extra heavy	$^{9}/_{16}$
¾ to ⅜	¾, double extra-heavy	$^{9}/_{16}$
¾ to ½	¾, double extra-heavy	$^{11}/_{16}$
1 to ¾	1, double extra-heavy	$^{29}/_{32}$
1¼ to 1	1¼, double extra-heavy	1⅛
1½ to 1	1½, double extra-heavy	1⅛
1½ to 1¼	1½, double extra-heavy	$1^{15}/_{32}$
2 to 1½	2, double extra-heavy	$1^{23}/_{32}$
2½ to 2	2½, double extra-heavy	$2^{3}/_{16}$
3 to 2½	3, double extra-heavy	$2^{9}/_{16}$
3½ to 3	3½, double extra-heavy	$3^{3}/_{16}$
4 to 3½	4, double extra-heavy	$3^{11}/_{16}$
4½ to 4	4½, double extra-heavy	$4^{3}/_{16}$

Guide Extension for Mounting Crossheads

The mounting of crossheads on two-bar locomotive guides is not usually a difficult task but it is an awkward one because of the links and trunnion frame directly above the back of the guides. This is true even though the crosshead is applied with the aid of a portable crane. This task, however, has been simplified considerably in the Union Pacific shops at Kansas City, Kan., by the guide-bar extension shown in the drawing.

When applying a crosshead, the yoke of the guide-bar extension is set around the bottom guide in front of the guide yoke, and the $^{13}/_{16}$-in. by $^{13}/_{16}$-in. key is placed in the 1-in. by 2½-in. key slot. The guide-bar extension can then be placed in position on the bottom guide-bar, and when in position, the back end is lowered until it rests on the floor. With the tool in this inclined position, the crosshead is lifted with a portable crane and



Guide-bar extension for mounting crossheads

placed on the guide-bar extension, allowing it to slip down until it rests against the small angle welded on the back end of the tool.

The back end of the guide-bar extension is then raised with the portable crane until it is level with the guides, after which the crosshead is shoved forward onto the guides either by hand or with a bar. Obviously the 4¾ in. width and 35 in. length of the crosshead seat of the bar shown in the drawing can be changed to suit dimensions of different classes of engines.

Taper Cutting Die Head

A heavy-duty taper-cutting die head for handling threads of large diameters, steep tapers, and extra lengths, has been added to the line of die heads manufactured by the Landis Machine Company, Waynesboro, Pa. Known as a special 6-in. Landmatic, it augments the line of Landmatic die heads with taper attachment previously manufactured in sizes up to 4 in. The head is of the six-chaser type and was designed for threading parts such as tool joints and drill stems.

This head is of the stationary type adapted for use on a heavy-duty turret lathe. An adjustable bar, mounted on some stationary part of the machine, retards the cam carrier as the head advances onto the work. The adjustable bar is set to have contact with the cam carrier just as the part to be threaded enters the die. The sliding movement of the cam along the cam shoe allows the chasers to recede at a uniform rate and produces a tapered thread corresponding to the taper of the cam. The head opens automatically when the cam trips off the end of the cam shoe.

Before the head is closed, the carriage must be returned a sufficient distance in order to clear the stop bar. The adjustment for thread length limits the forward travel of the cam carrier and insures threads of uniform diameter and length.

This die head can be supplied for cutting various

(Continued on page 92)

EXPERIENCE IS A GOOD TEACHER

"THE man should be taken out of service!" Master Mechanic Carter of the Plains Division on the S. P. & W. hit the desk with his clenched fist so hard the onyx desk set almost jumped off. The master mechanic slid the desk set back to a safer place. It was a Christmas gift from Mrs. Carter. He didn't dare get it broken so soon after Christmas.

"We can't put up with that kind of work, I tell you, and the only way to stop it is pull a few men out of service," Carter continued.

"But Mr. Carter," Jim Evans, the roundhouse foreman at Plainville said mildly, "perhaps it's not altogether Clark's fault that the rod bushing pounded out."

"The engine was out of tram, wasn't it? Clark put it up, didn't he?"

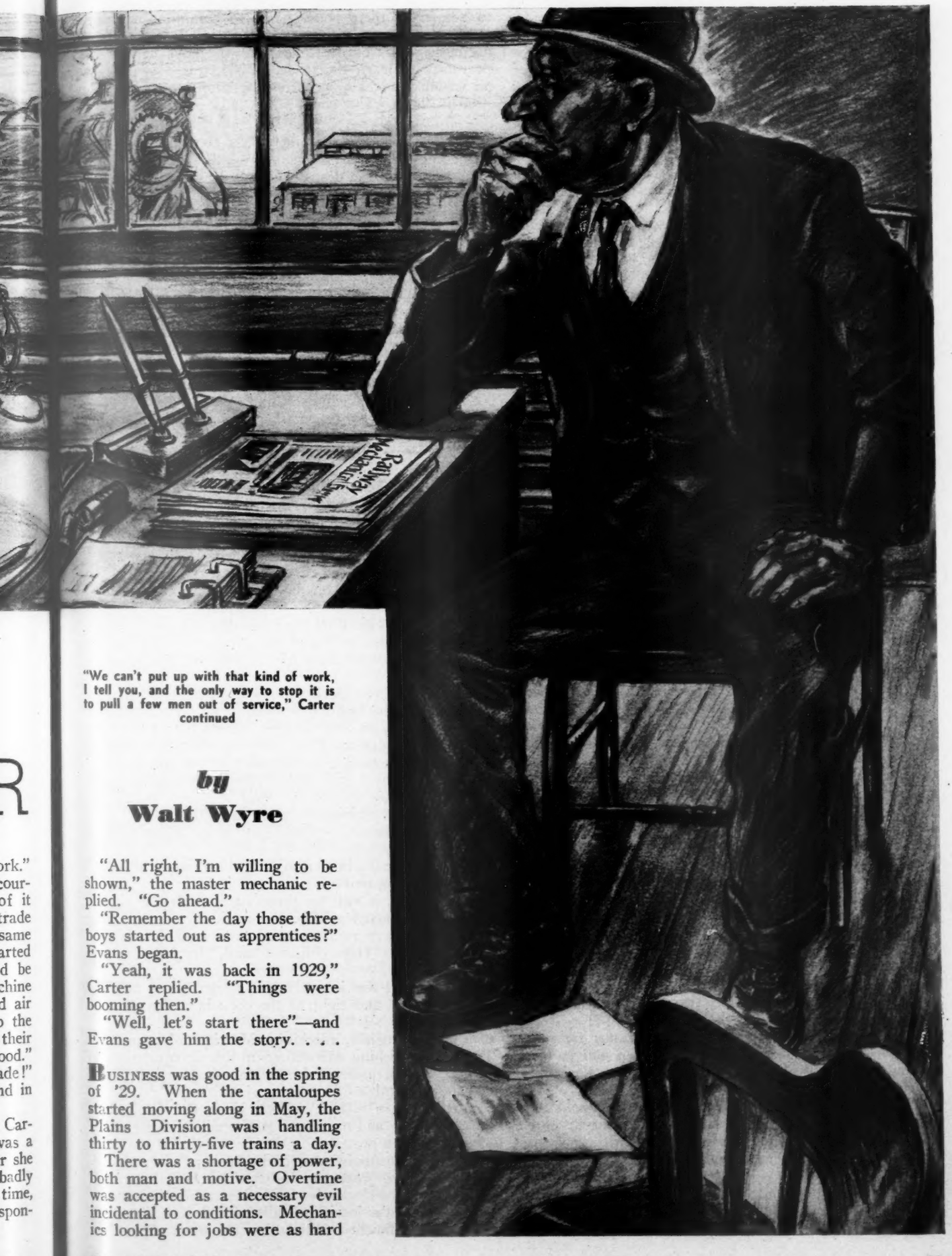
Evans shifted his chew of "horseshoe" to the other cheek. "Yes, that's true; the engine was out of tram and Clark put it up."

"He's a machinist, ain't he? Served his apprenticeship, didn't he?" Carter started to pound the desk again, looked at the elaborate fountain pen holder, and changed his mind. "We pay him machinist's wages! It's not our fault if he is not able to do a machinist's work."

"I'm not so sure about that," Evans disagreed courteously. "It's true Clark served his time, most of it right here in Plainville, but he didn't learn the trade and I wouldn't say it's entirely his fault. The same thing applies to Goodwin and Niles. All three started on their time together. None of the three could be called all-around mechanics. Clark is a good machine man, none better in the shop; Goodwin is a good air man; and Niles can wheel an engine and put up the rods quick as any man on the job. But, take them off their specialty and none of the three could be called good."

"It's not our fault if they didn't learn the trade!" Carter raised his clenched fist, then stuck his hand in his pocket.

"Don't think I'm trying to argue with you, Mr. Carter. I know your disposition to be fair. That was a rotten job Clark put up on the 5070; it's a wonder she didn't jerk all the rods off, the wheels were so badly out of tram. But, if you are willing to take the time, I believe I can show you where we are equally responsible for the failure."



"We can't put up with that kind of work, I tell you, and the only way to stop it is to pull a few men out of service," Carter continued

by

Walt Wyre

"All right, I'm willing to be shown," the master mechanic replied. "Go ahead."

"Remember the day those three boys started out as apprentices?" Evans began.

"Yeah, it was back in 1929," Carter replied. "Things were booming then."

"Well, let's start there"—and Evans gave him the story. . . .

BUSINESS was good in the spring of '29. When the cantaloupes started moving along in May, the Plains Division was handling thirty to thirty-five trains a day.

There was a shortage of power, both man and motive. Overtime was accepted as a necessary evil incidental to conditions. Mechanics looking for jobs were as hard

to find as Republican votes at last November's election.

"I have authority to put on some apprentices," Carter told Evans one day. "Who would you recommend?"

Evans named over half a dozen likely boys, sons of employees, that he thought would, with proper training, make good mechanics. Clark, Goodwin, and Niles were accepted. The master mechanic called the boys in the office and gave them a lecture. After the boys signed their indentures, he gave them some more advice.

Next morning at eight o'clock, the new apprentices came to work together. All were dressed alike in new overalls and spotless, blue polka-dot caps. The three boys stuck together like three lost chickens in a rainstorm until Evans had time after eight o'clock to assign them to their respective jobs. The foreman had talked with the three boys previously about where they preferred to start. Clark was placed in the machine shop, Goodwin started at the air bench, and Niles began at the drop-pit.

At the end of six months, each of the three boys could do a fair job of the particular class of work they had been doing. The work was still new enough not to be monotonous. Each of the apprentices, at their own request, were allowed to remain longer on the same jobs on which they had started. Two months later, when the fall slump hit, it was a case of be laid off or go to the back-shop. They chose the back-shop. Clark, at his own request, went in the tool room; Goodwin continued his work on air equipment; and Niles was pleased by being assigned to a job on the floor of the erecting shop.

At first the shop worked full time. Two evenings a week the boys, together with thirty-odd other apprentices, attended an apprentice class where they studied drafting, practical mathematics, and other essential subjects. The apprentice class was just getting into the study of valve motions when the shop closed down. When it reopened three months later with reduced force, the apprentice instructors were not called back. The apprentice school was no more for lack of an appropriation.

The apprentices were put on various jobs, but somehow the desire to learn was not as keen as before. What's the use, they reasoned, of learning a trade only to be cut off when the apprenticeship is finished. Thousands of mechanics were walking the streets looking for jobs, waiting and hoping for the elusive corner around which prosperity was said to be hiding.

The back-shops worked spasmodically as current finances would allow; some months, ten days; some, twenty; others, not at all. Some apprentices quit, hoping to find jobs with brighter looking futures. The three from Plainville stuck, more from lack of opportunity at something else than otherwise. At least it was a job that would keep them fed and clothed for the time being. What if they were cut off a large part of the time? That only postponed the date when they would finish their time and join the army of unemployed mechanics walking the streets.

So the boys worked on sans enthusiasm, sans inspiration, thinking mostly of quitting time and payday and how to fill the time between with as little inconvenience as possible.

The rows of technical books in the back-shop library accumulated a coating of dust. Subscriptions to journals of the trade were allowed to expire without being renewed. Correspondence courses were forgotten by most of the apprentices that had taken them out.

And so the time dragged on until in 1933 the back-shop closed down indefinitely. Clark, Goodwin, and Niles, more fortunate than many others, were allowed to return to their home point to continue the trade. When the apprentices returned to Plainville, Evans made a conscientious effort to see that the boys had an opportunity to learn the trade. Clark was placed at the air bench, Goodwin went on the drop-pit, while Niles went in the machine shop.

THE 5084 was undergoing Class 6 repairs and was about due off the drop-pit. As usual, Evans was short of power when the despatcher called and said he would need an additional engine next day. The 5076 burst a siphon.

"Well, the only thing I can see is run the 5082 on the extra and get the 5084 out for the east local," Evans told John Harris, the clerk.

"Can you get her out without overtime on her?" Harris inquired.

"Have to!" The foreman was emphatic. "They'll raise more hell about an hour overtime than twin boys with one bicycle." Evans bit off a hunk of "horseshoe" and headed for the roundhouse.

"Have you got the rod bushings finished for the 5084?" he asked machinist Cox.

"No, been tied up on running repair." The machinist indicated a stack of brasses to be turned that meant it would be some time before he could get around to the dead work.

Evans scratched his head and walked over to where Niles was going through the motions of operating a lathe. "Think you can make the bushings for the 5082?" the foreman asked.

"I think so," the apprentice replied.

"All right, take your time and see that they fit. I've got to run the engine on the east local in the morning," Evans said.

Niles went to work on the bushings. Goodwin, working with Jenkins on the drop-pit, was putting up the wheels. Evans told them of the necessity for finishing the engine.

Just before five o'clock, Goodwin started the left main bushing in. The bushing refused to go. He hit it several blows with an 8-lb. sledge. About half way in the bushing stuck again. Cox, busy on the other side of the engine, was paying no attention to the apprentice.

'Bushing sems a little tight," the apprentice yelled to Cox.

"Did it start all right?" the nut-splitter asked.

"Yeah," Goodwin replied, "but it go tight after it started."

"Well, maybe it's in a cramp. Hit it a couple of licks," Cox told the apprentice.

Goodwin hit it two or three times with the sledge. The bushing moved a little, but too slowly to suit him. He spied a heavy ram that had been used for driving in a main pin. "Hey, gimme a hand," he yelled to two laborers nearby.

The ram did the job. Half a dozen blows and the bushing was in and tight as the cork in a Scotchman's bottle.

In the meanwhile, machinist Martin and apprentice Clark were finishing connecting up the air equipment in the cab. Clark assembled the brake valve and placed it on the pedestal.

When the five o'clock whistle blew, the fire-builder had a fire going and the steam gage needle was beginning to quiver at the peg.

"We'll let the night men finish her up," Evans said.

Next morning when the foreman reached the roundhouse at seven o'clock, the 5084 was setting out on the lead ready for the local and called for 8:15. The foreman had just finished distributing the work slips when

the engineer blew three lusty blasts with the whistle of the 5082. A moment later the whistle again tooted insistently. Evans almost collided with the outbound inspector at the roundhouse door.

"Something wrong with the air on the 5084!" the inspector panted.

"What seems to be the trouble?" Evans asked.

"Don't know. It acts crazy," the inspector replied.

"Get Martin on it, right away," Evans said.

After a twenty-minute search the machinist decided the trouble was in the air-brake valve. The rotary valve had been turned just half around and the handle put on with the valve in that position. The engine was delayed thirty-five minutes.

Seven miles out of town the acrid odor of burning grease reached the engineer's nose. When he stopped the train, the left main pin was stinking hot. The back end of the main rod was beginning to turn blue from the heat. The hoghead cooled the hot brass, forced in some fresh grease and the engine made it to the next station four miles away, but not until the pin was so badly cut that it would require more than a new brass to put it in condition for another trip.

Evans used every cuss word he knew and made up some new ones for the occasion. He called the three apprentices in the office to talk to them.

"That's rotten work," Evans told the apprentices. "Rotten! How do you ever expect to be mechanics turning out jobs like that?"

The boys shuffled uneasily, looking at the floor, then Goodwin spoke up. "How can we ever expect to be mechanics, anyway? With thousands of machinists walking the streets, we can't expect to get a job when we finish our time."

"That's the way it looks now," Evans agreed, "but maybe things will get better by the time you finish."

"It's not likely," Clark said, "besides, we're not learning anything, not much, anyway. We're just serving a sentence with pay. The company is not trying very hard to teach us anything. I guess we just got a little disinterested," the apprentice added apologetically.

"What do you have to say, Niles?" Evans asked.

"Well, I'd rather be on the drop-pit than running a lathe. 'Course, I guess, the reason is that I've had more experience on the drop-pit and it's easier for me. I know I need the machine shop experience if I'm ever going to be a machinist, but being as there's mighty little chance of me getting a job when I finish, I'd rather be doing something that I can do." Niles sighed deeply as though relieved of a terrible load.

"Me too," Clark said. "I'd rather be running a lathe than fiddling around at that air bench."

"Well, I'd like to get off the drop-pit," Goodwin said.

Evans scratched his head thoughtfully. There was some logic in what the apprentice had said. At the same time, according to the agreement, apprentices should be given an opportunity to learn all branches of the trade and the time divided so as to give them the chance. The railroad would get more and better work with the men assigned to jobs they could do best.

"I'm going to put you boys on the jobs you prefer, starting in the morning. When you get ready to pitch in and learn the trade, I'll shift you around again."

The three apprentices finished their time working almost all of it on the jobs they had started out with. True to expectations, there were no jobs available when they finished. They worked at various and sundry jobs until in the fall of '36 the S. P. & W. began putting on men. The ex-apprentices were called in and given jobs. At first all three were on nights. Business picked up still more. Locomotives that were long overdue shopping had to have lots of work on them to keep them moving and additional mechanics were put on. Clark and Goodwin went on days. Clark managed to get a machine job, while Goodwin was forced to go on the drop-pit.

THEN one day Evans received a letter from the master mechanic saying that the allowance had been reduced. Working time had to be cut down. After a conference with representatives of the various crafts, it was decided to reduce the force on Saturdays and Sundays rather than cut off men.

"How'll we decide who'll work and who will be off?" Evans asked.

"That's easy," the machinist representative replied. "Just start at the top of the seniority list and take as many men as you need to work on days forces are reduced. The ones next on the list will work next time, and so on."

"Just keep rotating the men in order," the foreman said.

"That's the idea exactly," the machinist representative replied.

The others agreed that was fair and the method was adopted.

"How's the allowance coming?" Evans asked Harris, the clerk, on Thursday.

"Running over bad," the clerk replied.

"Well, we're just going to have to cut down more Saturday and Sunday," Evans said. "I don't see how we can get by, but the master mechanic says we've got to stay in the allowance."

SATURDAY morning the roundhouse force looked like a prayer meeting crowd on bank night at the picture show. Only four machinists were working, Clark, Goodwin, Martin, and Hill. Evans had the men lined up working only jobs that were absolutely necessary. He had it all figured out to get by in fairly good shape when the clerk found him at the board in the roundhouse.

"Despatcher says there'll be two extras east this evening and probably two sections of No. 10," the clerk said. "What'll I tell him?"

"Tell him that locomotives come twelve in a can and we'll have a fresh dozen if he'll send up the can opener." Evans' teeth snapped on a plug of "horseshoe." "I'll let him know soon as I can figure it out," the foreman added and started to the office.

"Now let's see," Evans mused, "I can let him have the 5081. It should be O.K. to go. The 5076 will be in on 71. What time's 72 doped to get in?" he asked the clerk.

"Ought to be in now," the clerk replied. "It's figured to be here at 9:40."

"Well, that's that! Tell old guess-and-grumble it'll be the 5081 and 5076. If they run two sections of No. 10, I'll figure that out later."

No. 71 rolled into town a few minutes later.

"Look her over quick as you can and tell the hostler I said to get her in the house soon as possible," Evans told the inspector.

The inspector climbed up in the cab of the engine. He glanced at the cab card, then looked again to be sure. "She's due for an annual," the inspector called out.

"What!" Evans' mouth dropped open like a trap door. He climbed up in the cab and looked at the card hoping the inspector was mistaken. He wasn't.

Evans climbed down from the cab of the engine and headed for the roundhouse like a man taking an out-

bound ticket to his mother-in-law. He made the round through the house—not another extra engine. If No. 10 ran in two sections, he could possibly use the engine that came in on the first one for the second, but that wouldn't help any for the two extras. They would run before the passenger was due in.

Not a chance of making an annual on the 5076. Evans passed the 5070 standing on the drop-pit. The engine was due out Monday. It would take less time to get the 5070 ready than it would to make an annual. He sent Clark and Goodwin with their helpers to the drop-pit.

"Throw your feet out, fellows, and get her finished soon as possible. I'll tell the fire-builder to fill her up and get a fire in her right away."

The men worked, no argument about that. At 6:30 the engine was ready to run out of the house. The second extra was called for 8:15.

An engine can be expected to run a little hot coming right off the drop-pit. To offset that, Evans gave instructions for extra grease to be put on the engine and for the rod cup man to take particular care to see that every bushing had plenty of grease. But grease doesn't do much good when the wheels are out of tram, at least as badly out as the ones on the 5070 Something had to give way. Fortunately it was brasses instead of rods. The trainload of cattle was delayed seven hours waiting until another engine could be sent to take the train on.

"Well, what are we going to do about it?" Carter asked when Evans had finished.

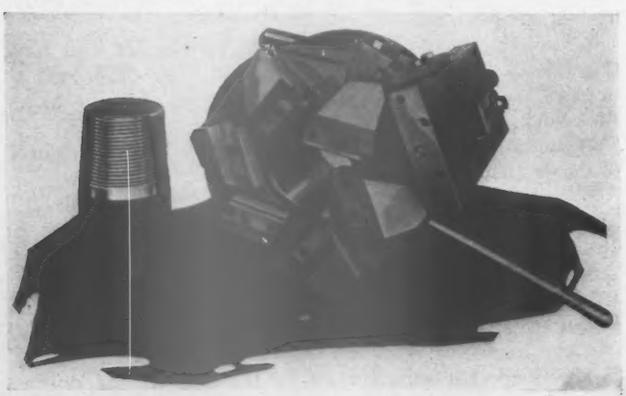
"There's one thing we can do, at least," Evans replied. "We can let this be a lesson. When we have apprentices learning a trade we can see that they learn it instead of taking the easy way out. We might need those same apprentices as mechanics some day."

Evans reached for his plug of "horseshoe" as Carter began fiddling with some papers on his desk.

Taper Cutting Die Head

(*Continued from page 87*)

diameters, tapers, and thread lengths. It was primarily designed for cutting threads of 6 in. outside diameter, 4 pitch, 2 in. taper per ft., and 5 in. length. The same

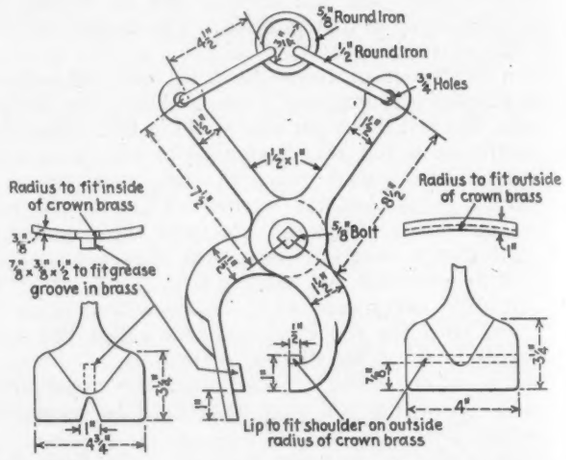


Landmatic 6-in. taper cutting die head

head can also be adapted for cutting threads of 5½ in. outside diameter, 4 pitch, 3 in. taper per ft. and 4¾ in. length; and threads of 4⅝ in. outside diameter, 4 pitch, 3 in. taper per ft., and 4 in. length.

Lifting Tongs For Crown Bearings

The weight of driving-box crown bearings often necessitates the use of some kind of a lifting device preparatory to pressing these bearings into the boxes. The tongs shown in the drawing are in use on one road for handling crown bearings weighing from 194 to 350 lb. each. These bearings are cast with a grease groove on the inside and a collar or flange on the outside. After


⅝" Round Iron
½" Round Iron
¾" Holes
Radius to fit inside of crown brass
Radius to fit outside of crown brass
⅝" Bolt
⅞ × ⅜ × ½ to fit grease groove in brass
Lip to fit shoulder on outside radius of crown brass
4"

Tongs for lifting heavy crown bearings during pressing operation

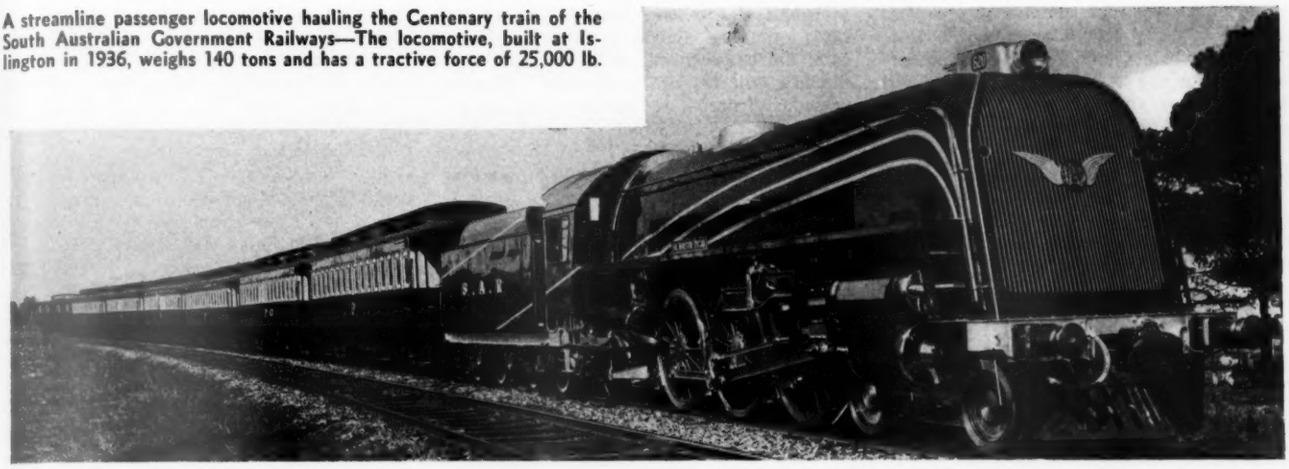
the crown bearing has been turned to size with a collar ⅜ in. high and then planed to fit the driving box, the tongs are then used with a hoist to lift the bearing up so it can be pressed into the box. It will be noticed that one leg of the tongs is provided with a lug to enter the grease groove while the other leg is made with a lip to catch under the turned collar of the bearing. Although some roads do not turn bearings with a collar, most all of them have the grease groove, thus permitting the use of tongs similar to the one shown.

Electrode for Small A.C. Arc Welders

The Wilson Welder and Metals Company, 60 East Forty-second Street, New York, has developed an electrode for use with small transformer-type a.c. arc welders. Although designed specifically for use with a.c. arc welders, this Wilson No. 520 electrode, as it has been designated, is said to be equally well adapted for d.c. machines. Tests are reported to have shown that the electrode deposits a smooth bead with slag interference reduced to a minimum. Heretofore, the welding performance of these small machines has been somewhat hampered due to an unstable arc caused by the alternating current. The No. 520 rod was developed to overcome this difficulty.

UNUSUAL HOBBY.—Railroad lantern collecting is the unusual hobby of a New Britain, Conn., man, who has 90, representing 40 railroads from New England to the Middle West. He has found them along railroad tracks, in attics, cellars, antique shops, and junk heaps. Two date back to 1860, one used by the Adams Express Company and the other from the New York, Lake Erie & Western.

A streamline passenger locomotive hauling the Centenary train of the South Australian Government Railways—The locomotive, built at Islington in 1936, weighs 140 tons and has a tractive force of 25,000 lb.



NEWS

I.C.C. Declines to Dismiss Power Reverse Gear Case

THE Interstate Commerce Commission on January 11 denied the petition filed by the Brotherhood of Locomotive Engineers and the Brotherhood of Locomotive Firemen and Enginemen for a dismissal of their complaint in the power-reverse gear case, because an agreement had been reached with the railroads on a plan for equipping locomotives with the power gear. The commission gave no reason for its denial but it was assumed that it desired to make a report following its long hearings in the case.

Burlington Zephyrs Pass Two-Million-Mile Mark

COINCIDENT with the arrival in Chicago and Denver on January 26 of the 12-car Burlington Zephyrs, the total mileage operated by the Burlington's fleet of eight streamline stainless-steel trains reached the two million mark. At the same time the 500,000-mile mark was passed by the two Denver Zephyrs.

First place in total mileage for individual Zephyrs goes to one of the former Twin Zephyrs, now the Ozark State Zephyr, operating between St. Louis and Kansas City, which has to its credit a total of 515,041 miles. The other small Twin, rechristened the Sam Houston, operating between Houston and Dallas, is credited with 508,938 miles. The pioneer Zephyr, operating between Lincoln and Kansas City, Mo., via Omaha, has an aggregate of 463,330 miles.

The James F. Lincoln Arc-Welding Foundation

TO STIMULATE intensive study of arc welding $200,000 will be distributed by the James F. Lincoln Arc Welding Foundation among winners of 446 separate prizes for papers dealing with arc welding as a primary process of manufacture, fabrication or construction in eleven major divisions of industry. The principal prize winner will receive not less than $13,700. Other prizes will range from $7,500 to $100, the latter sum to be awarded to each of 178 contestants who receive no other prize, but whose papers are adjudged worthy of honorable mention.

Among the eleven major divisions of industry eligible in this contest are the railroad field, the automotive field, the structural field and functional machinery. In the railroad field twenty-four prizes, with a total value of $14,200, will be awarded for the best papers on locomotives, freight cars, passenger cars, or locomotive and car parts.

The contest will close June 1, 1938. For complete details of the rules and conditions covering awards communicate promptly with the foundation secretary, A. F. Davis, P. O. Box 5728, Cleveland.

Institute for Social Progress

"THE World Challenge to Democracy—How Can America Meet It?" is to be the subject for discussion at the two weeks' Summer Institute for Social Progress to be held on the campus of Wellesley College, Wellesley, Mass., July 10 to 24. The point of view of mechanical engineers in the railway world is desired in the cross-section membership of the Institute and those men and women interested in the possibility of attending should write to G. L. Osgood, 14 West Elm avenue, Wollaston, Mass., for details and membership blanks. Dr. Colston E. Warne of the Economics Department of Amherst will lead in the discussion.

Charles A. Gill Honored

ABOUT 350 friends and well wishers of Charles A. Gill, recently made general manager of the Reading and Central Railroad of New Jersey lines, gave a dinner in his honor at the Berkshire Hotel, Reading, Pa., on the evening of January 18. Special trains were run to carry guests between both New York and Philadelphia and Reading. After-dinner talks were made by President E. W. Scheer of the Reading; Vice-President C. W. Galloway of the Baltimore & Ohio; Vice-President R. W. Brown of the Reading; Judge H. Robert Mays of Berks County, Pa.; C. A. Dana, president, Spicer Manufacturing Company; Roy V. Wright, editor, *Railway Mechanical Engineer*; D. W. Pye, president, Tuco Products Corporation; Arthur N. Dugan, vice-president, National Bearing Metals Corporation; George DeGuire, president, Ajax Hand Brake Company, and John O. Haines, president of the Reading Company's Booster Committee. General Superintendent P. S. Lewis, of the Reading, acted as toastmaster, and during the dinner several numbers were rendered by the Reading Company Glee Club. President Scheer, on behalf of the group, presented Mr. Gill with a star sapphire ring. Mr. Gill was recently elected president of the New York Railroad Club.

Equipment Building and Betterment Program

THE *Baltimore & Ohio*, on January 20, authorized the purchase of 2,000 gondola cars of 70 tons' capacity (1,450 of 52½ ft. and 550 of 65½ ft. length), and also the construction of 2,000 covered-wagon-top box cars, of 50 tons' capacity and 42½ ft. in length, in the company's shops. The construction of the 2,000 box cars in the company's shops will give employment to a large number of its employees throughout the remainder of the year. The total estimated cost of this equipment is approximately $10,000,000, the financing of which it is expected will be arranged through an equipment trust. A contract has been let to the Bethlehem Steel Company for 1,500 gondola cars, as noted in the new equipment table elsewhere in this issue.

Boston & Maine.—Fifty-five additional air-conditioned, deluxe passenger coaches will be placed in service by the Boston & Maine and the Maine Central as a part

of a $1,820,000 new equipment and materials order just placed by those roads.

The Pullman-Standard Car Manufacturing Company at Worcester, Mass., will build 20 new air-conditioned coaches for the Boston & Maine (as was reported in the January issue of the *Railway Mechanical Engineer*), at a cost of $40,000 each. These coaches will be of the 84-seat type with the latest appointments. Thirty of the present B. & M. all-steel coaches will be modernized, air-conditioned and have new de luxe seats and modern flooring and lighting installed at the B. & M. shops at Concord, N. H., and five all-steel coaches of the M. C. will be similarly modernized at its shops at Waterville, Me.

The re-conditioned coaches from the shops of the two railroads will commence to go into service in the spring, and the new cars from Pullman-Standard are expected to be ready for service this summer. Both the new and the re-conditioned deluxe coaches will be decorated in various color schemes, with the re-conditioned coaches being finished and upholstered in blues and browns. The new coaches will have an entirely new color scheme.

The orders also include 6,000 tons of rails and accessories for the Boston & Maine and 3,500 tons of rails and accessories for the Maine Central.

Canadian Pacific.—This road is carrying out a large air-conditioning program at its Angus shops in Montreal, according to an announcement by D. C. Coleman, vice-president of the company. A total of 136 cars including standard sleepers, dining cars, tourist sleepers, parlor cars and day coaches will be air conditioned. Having previously carried out similar work on 130 cars in 1936, this road upon completion of its new program, will be in a position to greatly extend its air-conditioned services throughout the Dominion.

Chicago, Milwaukee, St. Paul & Pacific.—The federal court at Chicago, on January 21, approved a petition of the Milwaukee's trustees to make application to the Interstate Commerce Commission for authority to finance 75 per cent of the cost of constructing new equipment with equipment trust certificates. The cars to be constructed in company shops during 1937 include: 500 fifty-ton steel hopper cars; 500 fifty-ton automobile cars; 7 dining cars; 1 mail-express car, and 5 coach-baggage cars. In addition, the court was asked to approve the construction in company shops of 1,000 gondola cars and 22 air dump cars.

Central Vermont.—At the St. Albans, Vt., shops of the Central Vermont, nearly $250,000 in outside repair work to locomotives and freight cars has been assigned for this year, according to an announcement made by Edmund Deschenes, vice-president of the road. This includes 15 locomotives from the Grand Trunk lines in New England for general repairs and 100 of the Canadian National's American-owned coal cars. About $8,000 will be spent on each locomotive and $1,200 on each coal car; a total repair bill of $240,000, one-half of which will represent labor costs, the remainder being for material. The Grand Trunk-Canadian National repair work is in addition to the regular Central Vermont work at the St. Albans shops. The Grand Trunk-Canadian National plans to air-condition, completely, trains operating over the Grand Trunk through local cities and eastern Canada.

Missouri-Kansas-Texas.—The M-K-T will spend approximately $5,000,000 for 1,279 freight and passenger cars, inquiry for which was reported in the January issue of the *Railway Mechanical Engineer*, and $10,000,000 for track and equipment maintenance. Locomotive shops at Waco, Texas, and Parsons, Kan., are now working with full-time crews on an extensive motive power repair and rebuilding program.

New York, New Haven & Hartford.—The trustees of this road on January 15 filed a petition in the United States District Court requesting authority to acquire 50 additional light-weight air-conditioned passenger coaches of the very latest type, and 5 modern cafeteria cars. The road recently placed in service substantially all of the 50 passenger cars authorized last March, but increased passenger traffic now requires additional coaches. The cost of the new coaches is estimated at $40,000 each, and of the cafeteria cars $45,000 each, to be financed in part by payments of cash and by means of an equipment trust.

New Equipment Orders and Inquiries Announced Since the Closing of the January issue

Locomotive Orders

Road	No. of locos.	Type of loco.	Builder
C. & I. M.	2	0-8-0	Lima Loco. Wks.
Guayaquil & Quito (Brazil)	2	2-8-0	Baldwin Loco. Wks.
New Orleans Public Belt	3	900-hp. Diesel-elec.	Baldwin Loco. Wks.
Nor. Pac.	9	4-6-6-4	American Loco. Co.
Union Pac.	25	4-6-6-4	American Loco. Co.

Locomotive Inquiries

Aluminum Co. of America	1	2-8-2	.....
Mo. Pac.	6	Diesel-elec. switch.	.....
Nor. Pac.	8	4-8-4	.....

Freight Car Orders

Road	No. of cars	Type of car	Builder
B. & O.	1,500[1]	Gondolas	Bethlehem Steel Co.
C. & N. W.	200	70-ton hoppers	Pullman-Std. Car Mfg. Co.
Illinois Central	500	Auto. box	Pullman-Std. Car Mfg. Co.
	500	Auto. box	American Car & Fdry. Co.
	800	Auto. box	Gen. American Trans. Corp.
	300	Refrigerator	Gen. American Trans. Corp.
	500	Hopper	Pressed Steel Car Co.
	500	Hopper	Ryan Car Co.
Ill. Terminal	100	50-ton mill type gondolas	Mt. Vernon Car Mfg. Co.
	50	50-ton flat	Mt. Vernon Car Mfg. Co.
St. L.-S. F.	600	Box	Company shops
	250	Hopper	Company shops
	20	Caboose	Company shops

Freight Car Inquiries

Mo. Pac.	700	50-ton gondolas	.....
	1,000	50-ton box	.....
	500	55-ton hopper	.....
	300	50-ton flat	.....
	25	30-ton caboose	.....
N. C. & St. L.	500	Box	.....
North American Car Corp.	200	40-ton refrigerator	.....
Nor. Pac.	750	50-ton gondolas	.....
	250	70-ton gondolas	.....
	500	50-ton flat	.....
	500	50-ton box	.....

Passenger Car Orders

Road	No. of cars	Type of car	Builder
Bangor & Aroostook	5[2]	de luxe coaches	Pullman-Std. Car Mfg. Co.
	2	Comb. mail and bagg.	Pullman-Std. Car Mfg. Co.

Passenger Car Inquiries

St. L.-S. W.	10	Chair	.....

[1] 1,200 of these cars will be 52 ft. 6 in. long inside and 300 will be 65 ft. 6 in. long.
[2] Three of the coaches will be arranged with a small kitchen for buffet service.

P. R. R. to Electrify to Harrisburg, Pa.

THE board of directors of the Pennsylvania, on January 27, authorized completion of the electrification of its lines for both passenger and freight service east of Harrisburg, Pa.

The chief parts of lines in the new electrification are the main line from Paoli, Pa., just west of Philadelphia, through Lancaster to Harrisburg; the low-grade freight line from Morrisville, Pa., near Trenton, N. J., via Columbia to Enola yard, near Harrisburg; the freight line from Columbia, Pa., following the course of the Susquehanna river to Perryville, Md., and the freight line from Monmouth Junction, N. J., to South Amboy, with the necessary yards, connecting branches and equipment. It will require about 18 months to complete the new work. The financing will be provided through a proposed $52,670,700 bond issue. The large freight and passenger yards at Harrisburg, Enola and South Amboy will be electrified to permit the movement of electrically-operated trains in and out of the yards and stations at these places. Additional yard electrification will also be installed at Philadelphia and Perryville. The company's announcement states that the new work will involve the electrification of 315 miles of line and 773 miles of track, and upon its completion, the Pennsylvania will have 2,677 miles of electrified trackage, or 41 per cent of the total electrically-operated standard railroad track in the United States.

(*Turn to next left-hand page*)

Modern Streamlined Power, built by Lima for the new Southern Pacific "Daylight" trains, which will operate between San Francisco and Los Angeles.

LIMA LOCOMOTIVE WORKS, LIMA LOCOMOTIVE WORKS INCORPORATED INCORPORATED, LIMA, OHIO

Supply Trade Notes

JAMES A. COOK, general sales agent of the Standard Forgings Corporation, Chicago, has been appointed vice-president, sales department.

THE CHICAGO RAILWAY EQUIPMENT COMPANY, Chicago, has moved its office at New York City from 90 West Broadway to 230 Park avenue.

C. W. MERRIKEN has been appointed director of sales of the asphalt division of the Continental Paint & Varnish Company, Chicago.

E. A. TURNER, vice-president of the Standard Stoker Company, Inc., has been appointed vice-president and general manager in charge of operations, with headquarters at New York.

DAVID S. YOUNGHOLM, vice-president of the Westinghouse Lamp Company has been elected vice-president of the Westinghouse Electric & Manufacturing Company. Mr. Youngholm's headquarters are at New York.

R. L. SALTER, superintendent of the Sayre, Pa., plant of the Southern Wheel Company, has been appointed chief inspector of the Association of Manufacturers of Chilled Car Wheels, with headquarters at Chicago.

THE WORTHINGTON PUMP & MACHINERY CORPORATION, Harrison, N. J., has absorbed its subsidiary, the Carbondale Machine Corporation. Carbondale organization products, and sales activities, will be continued as a division of Worthington.

FREDERICK W. LUCHT has been appointed to the engineering staff of the Carboloy Company, Detroit, Mich. Mr. Lucht was formerly with the McCrosky Tool Corporation at Meadville, Pa., and prior to that was with the Goddard & Goddard Tool Company, Detroit.

CLIFFORD L. SHEEN, sales representative of the American Locomotive Company at St. Louis, Mo., has been appointed technical assistant to the vice-president, with headquarters in New York. William F. Lewis succeeds Mr. Sheen as sales representative at St. Louis.

THE NORTHWEST MAGNESITE COMPANY has appointed The Celotex Corporation, Chicago, exclusive sales agent for Thermax structural insulation and Absorbex acoustical corrective. R. E. Bennett, of the Thermax Division of The Northwest Magnesite Company, is now connected with The Celotex Corporation.

H. I. DUNPHY and J. H. Van Moss have been appointed assistant vice-presidents in the sales division of the American Car and Foundry Company, with headquarters at New York; W. L. Richeson, previously in charge of sales in the Cleveland, Ohio, district, has been appointed manager of sales with headquarters at New York, and R. A. Williams has been appointed district sales manager in charge of the Cleveland district.

L. E. CARLSON has been appointed district engineer for the southeastern district of the Westinghouse Air Brake Company with headquarters at Washington, D. C. Mr. Carlson was graduated from the University of Washington, Seattle, Wash., in the class of 1926, in mechanical engineering, after which he became an apprentice at the Wilmerding plant, and subsequently served in various capacities in the engineering department as a test division engineer.

PIERCE T. WETTER, who for ten years has supervised the technical professional divisions of the American Society of Mechanical Engineers, has resigned to become executive vice-president of American Cutting Alloys, Inc., 500 Fifth avenue, New York. Mr. Wetter will have charge of the company's development in the manufacture and sale of cemented carbide titanium tips and cutting tools, particularly for the cutting of steel at high speeds. He also becomes vice-president and assistant treasurer of the American Electro Metal Corporation of Lewiston, Maine, manufacturers of molybdenum and tungsten products.

W. L. LENTZ, engineer of motive power of the New York Central System, has resigned to become associated with the Standard Stoker Company, Inc., as assistant to F. P. Roesch, vice-president, in the capacity of sales manager, with headquarters at New York. Mr. Lentz was

W. L. Lentz

born on January 29, 1895, at Jersey Shore, Pa., where he was educated in the public schools. He completed an International Correspondence School course in mechanical engineering, and during the years 1917 and 1918 attended military schools at Cornell University and Fort Sill, becoming a commissioned lieutenant in the Aviation Corps and instructing cadets in that branch of the service. He entered the service of the New York Central in May, 1913, and, after completing an apprentice course in the locomotive shops, was subsequently assigned to road test work. In 1919 he was appointed apprentice instructor in the locomotive and car shops at West Albany, N. Y., and in May, 1920, was transferred to the equipment engineering department of the N. Y. C. at New York, successively occupying the positions of designer, traveling inspector, assistant engineer of motive power, and engineer of motive power.

THE INTERNATIONAL NICKEL COMPANY has concluded a license for the United States and Foreign countries to make, use and sell under Armstrong Patents Nos. 1,997,538 and 2,044,742 clad products, plates, sheets, etc., using the electrolytic iron bonding or welding process which has been used by the Latrobe Electric Steel Company for the past few years and more recently by the Jessop Steel Company.

THE CARNEGIE-ILLINOIS STEEL CORPORATION, Joliet, Ill., has transferred its plant and property to the American Steel & Wire Company, the property included being the splice bar mills, spike mills, merchant mills, and bolt and nut factory. Two blast furnaces and the coke plant will be retained by Carnegie. With the exception of the blast furnaces and the coke plant, the operations formerly conducted by Carnegie will be under the management of the American Steel & Wire Company. Carnegie-Illinois will market the track accessories manufactured at the Joliet works as previously.

EASTERN RAILWAY SUPPLIES, INC., 110 East Forty-second street, New York, has been incorporated by Ralph W. Payne, Washington, D. C., and Stanley H. Smith, Cleveland, Ohio, to carry on a general railway supply business. Waldo E. Bugbee, formerly associated with the National Lock Washer Company, has been appointed representative of the company. Messrs. Payne and Smith will continue to carry on their present business in Washington and Cleveland, respectively. The Nordberg Manufacturing Company, Milwaukee, Wis., has appointed the Eastern Railway Supplies, Inc., its representative.

JOHN H. RODGER, who has been elected president of The Oxweld Railroad Service Company, Chicago, one of the units of the Union Carbide & Carbon Corporation, entered the railway supply business in New York in 1899 with the Standard Coupler Company. In 1911 he joined The Safety Car Heating & Lighting Company at Chicago, remaining with this organization 17 years, serving successively as representative, western manager, and vice-president in charge of the Chicago district, and subsequently, vice-president at New York. In 1928 he resigned to become vice-president

(Continued on next left-hand page)

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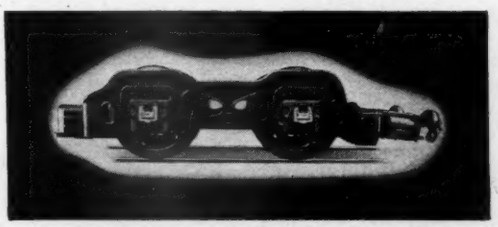
This experience can't be copied. Parts may appear the same, but they lack the background of knowledge and inherent value. For long, economical service and dependability of performance, specify Franklin Replacement parts for Franklin devices.



FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK CHICAGO MONTREAL

of The Oxweld Railroad Service Company, Chicago, and in 1930 was made executive vice-president, which position he held until his recent election as president.

Obituary

J. W. SAVAGE, railway sales representative of the DeVilbiss Company, Chicago, died in that city on December 31 of pneumonia.

RAYMOND C. DUDLEY, who retired as president of the Chicago Cleveland Car Roofing Company, Chicago, in 1925, died in that city on January 3 of heart failure. He had been connected with the railway supply business since 1906.

THEODORE H. GOODNOW, vice-president of the Camel Sales Company, Chicago, subsidiary of the Youngstown Steel Door Company, died in Oak Park, Ill., on January 1 of pneumonia. Mr. Goodnow was

Theodore H. Goodnow

born at Lathrop, Mo., on July 22, 1872, and entered railway service in 1890 with the Lake Shore & Michigan Southern (now part of the New York Central) at the Norwalk, Ohio, shops. In 1906 he was promoted to master car builder, which position he held until January, 1912, when he resigned to become general superintendent of the car shops of the Armour Car Lines. In August, 1912, he was appointed assistant superintendent and, subsequently, superintendent of the car department of the Chicago & North Western, which position he held until February, 1924, when he was elected vice-president of the Ryan Car Company. In September of that year he was elected vice-president of the Camel Sales Company.

HOWARD J. EVANS, in charge of railroad sales for The Lunkenheimer Company, Cincinnati, Ohio, died on January 5, at St. Petersburg, Florida, after an illness of several weeks. Mr. Evans had been associated with The Lunkenheimer Company since 1900.

Personal Mention

E. L. JOHNSON, assistant engineer of tests of the New York Central, has been appointed engineer of tests, with headquarters at New York, succeeding H. W. Faus.

E. L. BACHMAN, who has been appointed general superintendent of motive power of the New York zone of the Pennsylvania, with headquarters at New York, as noted in the January issue, was born in 1881

(C) *Harris & Ewing*
E. L. Bachman

at Coshocton, Ohio, and entered railroad service in 1902 in the Dennison, Ohio, shops of the Pennsylvania. After filling many positions in various shops and enginehouses he became master mechanic at Mingo Junction, Ohio, in 1926, and subsequently served in the same capacity at Wellsville, Ohio, and Olean, N. Y. Mr. Bachman was appointed master mechanic of the Philadelphia division in June, 1929, and just recently became general superintendent of motive power of the N. Y. zone.

THOMAS W. DEMAREST, who has been assigned to duty on the staff of the chief of motive power of the Pennsylvania at Philadelphia, Pa., as noted in the January issue, was born on March 18, 1868, at Englewood, N. J., and is a graduate of Stevens Institute of Technology, Hoboken, N.

T. W. Demarest

J. He entered the service of the Pittsburgh, Cincinnati & St. Louis (now P.R.R.) on August 1, 1889, as a special apprentice at Columbus, Ohio. From August, 1891, to February, 1896, he was assistant to superintendent motive power at Columbus, and from the latter date until February, 1897, assistant to master mechanic at Indianapolis, Ind. He served as general foreman locomotive department at Indianapolis from February, 1897, to August, 1899; master mechanic at Logansport, Ind., from August, 1899, to January, 1900 superintendent motive power, from January, 1900, to July, 1903, all with the Pittsburgh, Cincinnati & St. Louis and its successor, the Pittsburgh, Cincinnati, Chicago & St. Louis (now Pennsylvania). He was superintendent motive power, Northwest system, Pennsylvania Lines West of Pittsburgh, at Ft. Wayne, Ind., from July, 1903, until March, 1920, and from the latter date until June, 1925, served as general superintendent motive power, Northwestern region, Pennsylvania System, at Chicago. Mr. Demarest became general superintendent motive power of the Western region at Chicago in June, 1925, which position he was holding at the time of his transfer to Philadelphia.

H. H. HAUPT, who has been appointed general superintendent of motive power of the Central Region of the Pennsylvania, at Pittsburgh, Pa., as noted in the January issue, was born in Germany in 1892 and was educated at the Royal Wilhelms Gymna-

H. H. Haupt

sium at Cassel, Johns Hopkins University and the University of Pennsylvania. He entered railway service in 1911 as apprentice in the Altoona machine shops of the Pennsylvania, during the summer months, while continuing his college studies. In 1916 he was appointed motive power inspector and in November, 1917, became assistant master mechanic at Harrisburg. On October 1, 1918, Mr. Haupt was promoted to the position of assistant engineer of motive power, with headquarters at Williamsport,

(Continued on next left-hand page)

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Pa., where he remained until 1924, when he was appointed master mechanic at Wilmington, Del. In May, 1928, the Northwestern division was created and Mr. Haupt was appointed superintendent of motive power of that division at Chicago. In October, 1929, he was appointed superintendent of motive power of the Northern division at Buffalo, N. Y., and in May, 1932, became master mechanic of the Central division, at Buffalo. He was appointed superintendent of motive power of the Eastern and Central Pennsylvania divisions in November, 1933.

G. T. WILSON, former general equipment inspector (locomotives) of the New York Central, has been appointed automotive engineer, succeeding W. F. Collins.

W. C. WARDWELL has been appointed assistant to assistant chief engineer motive power and rolling stock of the New York Central, succeeding to the duties of G. T. Wilson, former general equipment inspector (locomotives).

A. C. MELANSON, superintendent of the St. Malo shops of the Canadian National, has been appointed superintendent of motive power and car equipment, Quebec district, succeeding H. W. Sharpe, who has retired. Mr. Melanson will continue to have jurisdiction over the St. Malo shops in addition to his new duties.

A. K. GALLOWAY, who has been appointed superintendent of motive power and rolling equipment of the Reading and the Central of New Jersey at Reading, Pa., as noted in the January issue, was born

A. K. Galloway

on October 1, 1885, at St. Thomas, Ont. He entered the service of the Baltimore & Ohio on November 1, 1914, as master mechanic on the Baltimore division and in July, 1916, he was appointed district master mechanic of the Northwest district, being transferred in the same capacity to the Maryland district in February, 1917. Mr. Galloway served in the latter position until April, 1927, when he was appointed superintendent motive power of the Western lines of the Baltimore & Ohio, with headquarters at Cincinnati, Ohio, and subsequently he was transferred as superintendent motive power to the Eastern lines, with headquarters at Baltimore. He was holding the latter position at the time of his appointment as superintendent of motive power and rolling stock at Reading.

W. F. COLLINS, automotive engineer of the New York Central, has been appointed assistant engineer of tests, succeeding E. L. Johnson.

CHARLES A. GILL, who has been appointed general manager of the Reading and the Central of New Jersey at Reading, Pa., as noted in the January issue, entered the service of the Baltimore & Ohio in 1896 as a call boy in the motive power department, later becoming a machinist in

Charles A. Gill

the Mount Clare (Baltimore) shops of the same company. In the years following he acquired a varied experience as mechanic, general foreman, master mechanic and general master mechanic. On February 1, 1917, he was appointed superintendent of motive power of the Eastern lines of the Baltimore & Ohio, remaining in that position until February 10, 1931, when he accepted from the Soviet government a one-year appointment as chief consulting engineer of the railway systems of the Union of Soviet Socialist Republics. In that capacity he aided in the development of motive power and other equipment problems of the Soviet system, and also advised in the expenditure of the 1931 Russian railroad budget, amounting to $1,700,000,000 and covering some 60,000 miles of line. Mr. Gill's first position upon his return from Russia early in 1932 was assistant to chief motive power and equipment of the Baltimore & Ohio. He became special representative of the Reading later in 1932 and in September of the same year was appointed superintendent motive power and rolling equipment of the Reading Company. His jurisdiction was extended to include the Central of New Jersey on September 1, 1933. He now becomes general manager of the companies.

H. W. SHARPE, superintendent of motive power and car equipment of the Quebec district of the Canadian National, has retired. Mr. Sharpe was born on December 6, 1869, at Campbellton, N. B. He entered railroad service in September, 1883, as a messenger of the Intercolonial Railway (now Canadian National) at Campbellton. He became a helper in the mechanical shops of the Intercolonial at Campbellton in August, 1884; locomotive fireman in that city in November, 1886, and locomotive engineer at Levis, Que., in February, 1890. Mr. Sharpe served as division master mechanic of the Intercolonial successively at Riviere du Loup, Que., and Levis from November, 1912, to December, 1918, when he became district master mechanic of the Canadian National at Quebec, Que. On March 1, 1923, he was appointed superintendent of motive power and car equipment at Quebec.

H. W. FAUS, engineer of tests of the New York Central System, with headquarters at New York, has been appointed engineer of motive power, succeeding W. L. Lentz, who has resigned. Mr. Faus was born on July 28, 1886, at Munsey Valley, Pa. He was graduated from Syracuse University in 1910 with a degree in civil engineering. He began his business career in 1901 in the office of the Lehigh Valley Coal Company at Snow Shoe, Pa., serving with this firm until 1904. During the summer of 1905 he worked as colliery clerk with the Pennsylvania Coal & Coke Company at Hastings, Pa. Mr. Faus entered railroad service in 1910 and served until 1912 as rodman, leveler, transitman, bridge inspector and bridge engineer with the Canadian Northern (now C. N. R.) in Ontario and British Columbia. From 1912 to 1915 he was resident engineer of the Kettle Valley (C. P. R. system) at Hope, B. C., and Penticton, B. C., and from 1915 to 1917 was special engineer of the New York Central Lines at New York. He served successively as office

H. W. Faus

engineer, plant engineer, resident engineer and chief administrative officer for the U. S. Shipping Board Emergency Fleet Corporation, Bristol, Pa., from 1917 to 1923. From 1923 to 1926 he was special engineer and engineer materials and equipment tests with the New York Central. In 1926 he became engineer of tests.

Master Mechanics and Road Foremen

J. C. HARRIS, master mechanic of the Southern Pacific at El Paso, Tex., has retired.

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J. L. CATO has been appointed master mechanic of the Southern Pacific Lines in Texas and Louisiana, with headquarters at El Paso, Tex., succeeding J. C. Harris.

H. C. WYATT, formerly a foreman at the Iaeger, W. Va., shop of the Norfolk & Western, has been promoted to the position of assistant road foreman of engines, Pocahontas division.

C. P. BLAIR, a draftsman in the office of the mechanical engineer of the Norfolk & Western at Roanoke, Va., has been transferred to the Radford division as assistant road foreman of engines.

J. S. BELL, assistant enginehouse foreman on the Philadelphia Terminal division of the Pennsylvania, has been appointed assistant master mechanic of the Columbus, Cincinnati and Toledo divisions, with headquarters at Columbus, Ohio.

ELMER A. KUHN, master mechanic of the Canadian division of the Pere Marquette at St. Thomas, Ont., has been transferred to Saginaw, Mich., as master mechanic of the Saginaw district.

M. L. CRAWFORD, master mechanic of the St. Louis-San Francisco at Sherman, Tex., has been transferred to Springfield, Mo., to succeed J. L. Harvey, who has resigned.

H. REES, master mechanic of the Western lines of the Baltimore & Ohio at Akron, Ohio, has been appointed district master mechanic with headquarters at Cincinnati, Ohio, succeeding E. J. McSweeney.

WALTER F. HARRIS, general foreman of the Akron and Chicago divisions of the Baltimore & Ohio at Willard, Ohio, has been appointed division master mechanic, with headquarters at Akron, Ohio. Mr. Harris was born at Cannelsburg, Ind., on January 20, 1884, and attended public school at Washington, Ind. He became a machinist apprentice in the employ of the Baltimore & Ohio at Washington, Ind., on November 6, 1900; machinist at Washington on November 6, 1904; general foreman at Seymour, Ind., on October 6, 1909; general foreman at Washington on September 20, 1914; master mechanic at Flora, Ill., on July 16, 1916; district motive power inspector on March 1, 1919, and master mechanic at Willard, Ohio, on February 21, 1927. On February 1, 1933, with the consolidation of the Akron and Chicago divisions, Mr. Harris became general foreman at Willard.

Shop and Enginehouse

J. P. BECKER, general locomotive inspector of the Chicago, Great Western at Oelwein, Iowa, has been appointed general locomotive and boiler inspector.

H. B. ROBINSON, gang leader of the Norfolk & Western at Crewe, Va., has been promoted to the position of foreman at the Iaeger, W. Va., shop.

Purchasing and Stores

A. C. JOHNSON, district storekeeper of the Como store of the Northern Pacific at St. Paul, Minn., has been transferred to South Tacoma, Wash., replacing H. A. Humes, deceased.

K. H. SUDER has been appointed purchasing agent of the Akron, Canton & Youngstown and the Northern Ohio, with headquarters at Akron, Ohio.

Obituary

WILLARD KELLS, formerly general superintendent motive power of the Atlantic Coast Line, died suddenly of heart disease at his home in Wilmington, N. C., on January 18. Mr. Kells was born in Dennison, Ohio, on February 4, 1868. He was educated in the public schools of Cleveland, Ohio, and on March 1, 1888, entered railroad service as a machinist apprentice on

Willard Kells

the Erie at Susquehanna, Pa. After serving his full apprenticeship he rose through various positions to become master mechanic at Cleveland, Ohio; Lima, Ohio; Huntington, Ind., and Meadville, Pa. For a short time he was assistant master car builder of the Union Tank Line at New York, and from April, 1899, to December, 1910, was master mechanic of the Lehigh Valley successively at Auburn, N. C.; Sayre, Pa., and Buffalo, N. Y. In December, 1910, he became assistant to general superintendent motive power of the Atlantic Coast Line at Wilmington, N. C. From 1911 to 1918 he was assistant general superintendent motive power, and from 1918 to 1920 general superintendent motive power. Because of failing health, he relinquished many of his duties and was superintendent motive power until his resignation in October, 1923.

F. D. CAMPBELL, assistant superintendent, car department, Chicago, Milwaukee, St. Paul & Pacific, Tacoma, Wash., died at Tacoma on December 14, 1936. Mr. Campbell was born in Prairie du Chien, Wis., April 10, 1863, and entered Milwaukee Road service in 1879 at Farmington, Minn. In 1882 he went with the car department as a bridge and building carpenter and cabinet maker. In 1892 he was coach yard foreman at Minneapolis, and in 1893 became car foreman at Aberdeen, S. D., where he remained until 1907, when he went to Lines West as general foreman. In 1917, he was appointed assistant superintendent.

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers. State the name and number of the bulletin or catalog desired, when mentioned in the description.

BEAVER PIPE TOOLS.—Catalog No. 37, issued by Beaver Pipe Tools, 330-770 Dana Ave., Warren, Ohio, includes 40 new and 18 improved Beaver items brought out since 1929.

ELESCO EQUIPMENT.—The new Elesco equipped passenger locomotives for the Canadian National Railways are featured in the four page bulletin issued by The Superheater Company, 60 East Forty-second street, New York.

THREADING EQUIPMENT.—The entire line of Oster-Williams pipe and bolt threading equipment and welding equipment is illustrated and described in the catalog of the Oster Manufacturing Co., 2087 East Sixty-First Place, Cleveland, Ohio.

AIRCO ACETYLENE.—In a 12-page booklet the Air Reduction Sales Company, 60 East Forty-Second street, New York, presents the story of acetylene vs. various other fuel gases—its history, heating, efficiency and B.t.u. heat values, etc.

DIESEL ENGINES.—The Cooper-Bessemer Corporation, Mt. Vernon, Ohio, has released a bulletin describing their Type GN Diesel, built in three, four, six and eight cylinders and rated at 50 to 58 hp. per cylinder. Powering Diesel railway locomotives is listed among the major applications of the Type GN Diesels.

"FINISHES FOR ALUMINUM."—The Aluminum Company of America, Pittsburgh, Pa., has prepared this spiral-bound booklet to assist the users of aluminum in solving their finishing problems. The discussions cover the characteristics of aluminum, mechanical finishes, chemical dip finishes, electrolytic oxide finishes, electroplating on aluminum, "Alclad" products, and paint, lacquer and enamel finishes.

SYLPHON CONTROL.—The Fulton Sylphon Company, Drexel building, Philadelphia, Pa., has issued two 4-page bulletins descriptive of the Sylphon control of passenger-car heating and the Sylphon control on ice-activated cars. The arrangements of the modulating temperature control and the automatic differential control, respectively, on these installations are shown diagrammatically.

VALVES AND FITTINGS.—Standard Marking.—A new edition of the "MSS Standard Practice," SP-25, covering MSS standard marking system for valves, fittings, flanges and unions has been issued by the Manufacturers Standardization Society of the Valve and Fittings Industry, 420 Lexington avenue, New York. A number of tables definitely outlining the standard method of applying uniform markings to a wide variety of products more specifically visualize the general rules. The price of this edition is 50 cents.